

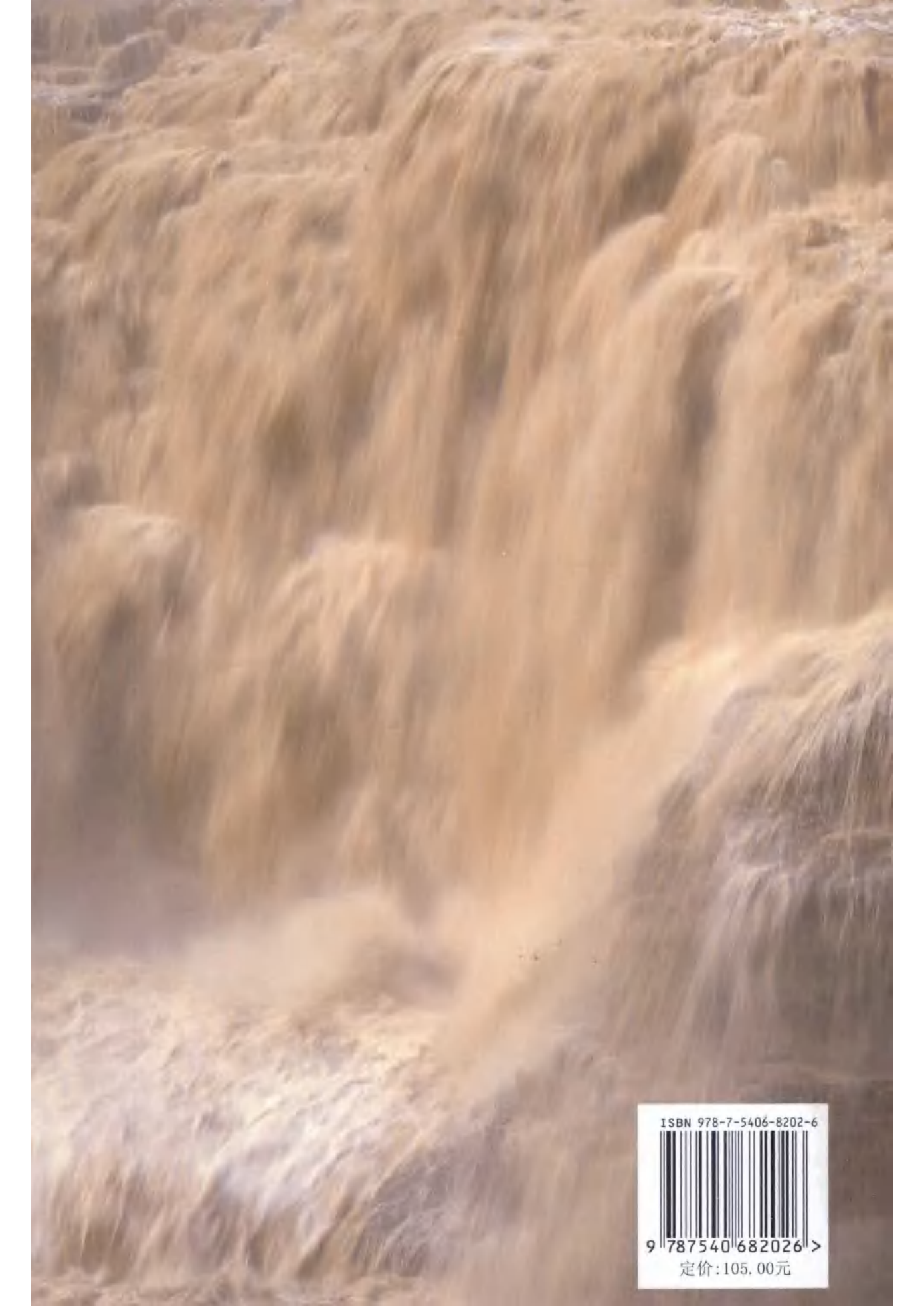
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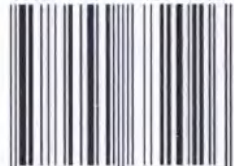
汉英对照

天工开物

TIAN GONG
KAI WU



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天工开物

Tian Gong Kai Wu



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总 序

杨牧之

《大中华文库》终于出版了。我们为之高兴，为之鼓舞，但也倍感压力。

当此之际，我们愿将郁积在我们心底的话，向读者倾诉。

—

中华民族有着悠久的历史 and 灿烂的文化，系统、准确地将中华民族的文化经典翻译成外文，编辑出版，介绍给全世界，是几代中国人的愿望。早在几十年前，西方一位学者翻译《红楼梦》，将书名译成《一个红楼上的梦》，将林黛玉译为“黑色的玉”。我们一方面对国外学者将中国的名著介绍到世界上去表示由衷的感谢，一方面为祖国的名著还不被完全认识，甚至受到曲解，而感到深深的遗憾。还有西方学者翻译《金瓶梅》，专门摘选其中自然主义描述最为突出的篇章加以译介。一时间，西方学者好像发现了奇迹，掀起了《金瓶梅》热，说中国是“性开放的源头”，公开地在报刊上鼓吹中国要“发扬开放之传统”。还有许多资深、友善的汉学家译介中国古代的哲学著作，在把中华民族文化介绍给全世界的工作方面作出了重大贡献，但或囿于理解有误，或缘于对中国文字认识的局限，质量上乘的并不多，常常是隔靴搔痒，说不到点子上。大哲学家黑格尔曾经说过：中国有



最完备的国史。但他认为中国古代没有真正意义上的哲学，还处在哲学史前状态。这么了不起的哲学家竟然作出这样大失水准的评论，何其不幸。正如任何哲学家都要受时间、地点、条件的制约一样，黑格尔也离不开这一规律。当时他也只能从上述水平的汉学家译过去的文字去分析、理解，所以，黑格尔先生对中国古代社会的认识水平是什么状态，也就不难想象了。

中国离不开世界，世界也缺少不了中国。中国文化摄取外域的新成分，丰富了自己，又以自己的新成就输送给别人，贡献于世界。从公元5世纪开始到公元15世纪，大约有一千年，中国走在世界的前列。在这一千多年的时间里，她的光辉照耀全世界。人类要前进，怎么能不全面认识中国，怎么能不认真研究中国的历史呢？

二

中华民族是伟大的，曾经辉煌过，蓝天、白云、阳光灿烂，和平而兴旺；也有过黑暗的、想起来就让人战栗的日子，但中华民族从来是充满理想，不断追求，不断学习，渴望和平与友谊的。

中国古代伟大的思想家孔子曾经说过：“三人行，必有我师焉。择其善者而从之，其不善者而改之。”孔子的话就是要人们向别人学习。这段话正是概括了整个中华民族与人交往的原则。人与人之间交往如此，在与周边的国家交往中也是如此。

秦始皇第一个统一了中国，可惜在位只有十几年，来不及做更多的事情。汉朝继秦而继续强大，便开始走出去，了



解自己周边的世界。公元前 138 年，汉武帝派张骞出使西域。他带着一万头牛羊，总值一万万钱的金帛货物，作为礼物，开始西行，最远到过“安息”（即波斯）。公元 73 年，班超又率 36 人出使西域。36 个人按今天的话说，也只有一个排，显然是为了拜访未曾见过面的邻居，是去交朋友。到了西域，班超派遣甘英作为使者继续西行，往更远处的大秦国（即罗马）去访问，“乃抵条支而历安息，临西海以望大秦”（《后汉书·西域传》）。“条支”在“安息”以西，即今天的伊拉克、叙利亚一带，“西海”应是今天的地中海。也就是说甘英已经到达地中海边上，与罗马帝国隔海相望，“临大海欲渡”，却被人劝阻而未成行，这在历史上留下了遗憾。可以想见班超、甘英沟通友谊的无比勇气和强烈愿望。接下来是唐代的玄奘，历经千难万险，到“西天”印度取经，带回了南亚国家的古老文化。归国后，他把带回的佛教经典组织人翻译，到后来很多经典印度失传了，但中国却保存完好，以至于今天，没有玄奘的《大唐西域记》，印度人很难编写印度古代史。明代郑和“七下西洋”，把中华文化传到东南亚一带。鸦片战争以后，一代又一代先进的中国人，为了振兴中华，又前赴后继，向西方国家学习先进的科学思想和文明成果。这中间有我们的领导人朱德、周恩来、邓小平；有许许多多大科学家、文学家、艺术家，如郭沫若、李四光、钱学森、冼星海、徐悲鸿等。他们的追求、奋斗，他们的博大胸怀，兼收并蓄的精神，为人类社会增添了光彩。

中国文化的形成和发展过程，就是一个以众为师、以各国人民为师，不断学习和创造的过程。中华民族曾经向周边国家和民族学习过许多东西，假如没有这些学习，中华民族绝不可能创造出昔日的辉煌。回顾历史，我们怎么能够不对



伟大的古埃及文明、古希腊文明、古印度文明满怀深深的感激?怎么能够不对伟大的欧洲文明、非洲文明、美洲文明、澳洲文明,以及中国周围的亚洲文明充满温情与敬意?

中华民族为人类社会曾作出过独特的贡献。在15世纪以前,中国的科学技术一直处于世界遥遥领先的地位。英国科学家李约瑟说:“中国在公元3世纪到13世纪之间,保持着一个西方所望尘莫及的科学知识水平。”美国耶鲁大学教授、《大国的兴衰》的作者保罗·肯尼迪坦言:“在近代以前时期的所有文明中,没有一个国家的文明比中国更发达,更先进。”

世界各国的有识之士千里迢迢来中国观光、学习。在这个过程中,中国唐朝的长安城渐渐发展成为国际大都市。西方的波斯、东罗马,东亚的高丽、新罗、百济、南天竺、北天竺,频繁前来。外国的王侯、留学生,在长安供职的外国官员,商贾、乐工和舞士,总有几十个国家,几万人之多。日本派出的“遣唐使”更是一批接一批。传为美谈的日本人阿部仲麻吕(晁衡)在长安留学的故事,很能说明外国人与中国的交往。晁衡学成仕于唐朝,前后历时五十余年。晁衡与中国的知识分子结下了深厚的友情。他归国时,传说在海中遇难身亡。大诗人李白作诗哭悼:“日本晁卿辞帝都,征帆一片绕蓬壶。明月不归沉碧海,白云愁色满苍梧。”晁衡遇险是误传,但由此可见中外学者之间在中国长安交往的情谊。

后来,不断有外国人到中国来探寻秘密,所见所闻,常常让他们目瞪口呆。《希腊纪事》(希腊人波桑尼阿著)记载公元2世纪时,希腊人在中国的见闻。书中写道:“赛里斯人用小米和青芦喂一种类似蜘蛛的昆虫,喂到第五年,虫肚子胀裂开,便从里面取出丝来。”从这段对中国古代养蚕技术的



描述，可见当时欧洲人与中国人的差距。公元9世纪中叶，阿拉伯人来到中国。一位阿拉伯作家在他所著的《中国印度闻见录》中记载了曾旅居中国的阿拉伯商人的见闻：

——一天，一个外商去拜见驻守广州的中国官吏。会见时，外商总盯着官吏的胸部，官吏很奇怪，便问：“你好像总盯着我的胸，这是怎么回事？”那位外商回答说：“透过你穿的丝绸衣服，我隐约看到你胸口上长着一个黑痣，这是什么丝绸，我感到十分惊奇。”官吏听后，失声大笑，伸出胳膊，说：“请你数数吧，看我穿了几件衣服。”那商人数过，竟然穿了五件之多，黑痣正是透过这五层丝绸衣服显现出来的。外商惊得目瞪口呆，官吏说：“我穿的丝绸还不算是最好的，总督穿的要更精美。”

——书中关于茶（他们叫干草叶子）的记载，可见阿拉伯国家当时还没有喝茶的习惯。书中记述：“中国国王本人的收入主要靠盐税和泡开水喝的一种干草税。在各个城市里，这种干草叶售价都很高，中国人称这种草叶叫‘茶’，这种干草叶比苜蓿的叶子还多，也略比它香，稍有苦味，用开水冲喝，治百病。”

——他们对中国的医疗条件十分羡慕，书中记载道：“中国人医疗条件很好，穷人可以从国库中得到药费。”还说：“城市里，很多地方立一石碑，高10肘，上面刻有各种疾病和药物，写明某种病用某种药医治。”

——关于当时中国的京城，书中作了生动的描述：中国的京城很大，人口众多，一条宽阔的长街把全城分为两半，大街右边的东区，住着皇帝、宰相、禁军及皇家的总管、奴婢。在这个区域，沿街开凿了小河，流水潺潺；路旁，葱茏的树木整然有序，一幢幢宅邸鳞次栉比。大街左边的西区，



住着庶民和商人。这里有货栈和商店，每当清晨，人们可以看到，皇室的总管、宫廷的仆役，或骑马或步行，到这里来采购。

此后的史籍对西人来华的记载，渐渐多了起来。13世纪意大利旅行家马可·波罗，尽管有人对他是否真的到过中国持怀疑态度，但他留下一部记述元代事件的《马可·波罗游记》却是确凿无疑的。这部游记中的一些关于当时中国的描述使得西方人认为是“天方夜谭”。总之，从中西文化交流史来说，这以前的时期还是一个想象和臆测的时代，相互之间充满了好奇与幻想。

从16世纪末开始，由于航海技术的发展，东西方航路的开通，随着一批批传教士来华，中国与西方开始了直接的交流。沟通中西的使命在意大利传教士利玛窦那里有了充分的体现。利玛窦于1582年来华，1610年病逝于北京，在华二十余年。除了传教以外，做了两件具有历史象征意义的事，一是1594年前后在韶州用拉丁文翻译《四书》，并作了注释；二是与明代学者徐光启合作，用中文翻译了《几何原本》。

西方传教士对《四书》等中国经典的粗略翻译，以及杜赫德的《中华帝国志》等书对中国的介绍，在西方读者的眼前展现了一个异域文明，在当时及稍后一段时期引起了一场“中国热”，许多西方大思想家都曾注目于中国文化。有的推崇中华文明，如莱布尼兹、伏尔泰、魁奈等，有的对中华文明持批评态度，如孟德斯鸠、黑格尔等。莱布尼兹认识到中国文化的某些思想与他的观念相近，如周易的卦象与他发明的二进制相契合，对中国文化给予了热情的礼赞；黑格尔则从他整个哲学体系的推演出发，认为中国没有真正意义上的哲学，还处在哲学史前的状态。但是，不论是推崇还是批



评，是吸纳还是排斥，中西文化的交流产生了巨大的影响。随着先进的中国科学技术的西传，特别是中国的造纸、火药、印刷术和指南针四大发明的问世，大大改变了世界的面貌。马克思说：“中国的火药把骑士阶层炸得粉碎，指南针打开了世界市场并建立了殖民地，而印刷术则变成了新教的工具，变成对精神发展创造必要前提的最强大的杠杆。”英国的哲学家培根说：中国的四大发明“改变了全世界的面貌和一切事物的状态”。

三

大千世界，潮起潮落。云散云聚，万象更新。中国古代产生了无数伟大的科学家：祖冲之、李时珍、孙思邈、张衡、沈括、毕昇……产生了无数科技成果：《齐民要术》、《九章算术》、《伤寒杂病论》、《本草纲目》……以及保存至今的世界奇迹：浑天仪、地动仪、都江堰、敦煌石窟、大运河、万里长城……但从15世纪下半叶起，风水似乎从东方转到了西方，落后的欧洲只经过400年便成为世界瞩目的文明中心。英国的牛顿、波兰的哥白尼、德国的伦琴、法国的居里、德国的爱因斯坦、意大利的伽利略、俄国的门捷列夫、美国的费米和爱迪生……光芒四射，令人敬仰。

中华民族开始思考了。潮起潮落究竟是什么原因？中国人发明的火药，传到欧洲，转眼之间反成为欧洲列强轰击中国大门的炮弹，又是因为什么？

鸦片战争终于催醒了中国人沉睡的迷梦，最先“睁眼看世界”的一代精英林则徐、魏源迈出了威武雄壮的一步。曾国藩、李鸿章搞起了洋务运动。中国的知识分子喊出“民主



与科学”的口号。中国是落后了，中国的志士仁人在苦苦探索。但落后中饱含着变革的动力，探索中孕育着崛起的希望。“向科学进军”，中华民族终于又迎来了科学的春天。

今天，世界毕竟来到了 21 世纪的门槛。分散隔绝的世界，逐渐变成联系为一体的世界。现在，全球一体化趋势日益明显，人类历史也就在愈来愈大的程度上成为全世界的历史。当今，任何一种文化的发展都离不开对其它优秀文化的汲取，都以其它优秀文化的发展为前提。在近现代，西方文化汲取中国文化，不仅是中国文化的传播，更是西方文化自身的创新和发展；正如中国文化对西方文化的汲取一样，既是西方文化在中国的传播，同时也是中国文化在近代的转型和发展。地球上所有的人类文化，都是我们共同的宝贵遗产。既然我们生活的各个大陆，在地球史上曾经是连成一气的“泛大陆”，或者说是一个完整的“地球村”，那么，我们同样可以在这个以知识和学习为特征的网络时代，走上相互学习、共同发展的大路，建设和开拓我们人类崭新的“地球村”。

西学仍在东渐，中学也将西传。各国人民的优秀文化正日益迅速地为中国文化所汲取，而无论西方和东方，也都需要从中国文化中汲取养分。正是基于这一认识，我们组织出版汉英对照版《大中华文库》，全面系统地翻译介绍中国传统文化典籍。我们试图通过《大中华文库》，向全世界展示，中华民族五千年的追求，五千年的梦想，正在新的历史时期重放光芒。中国人民就像火后的凤凰，万众一心，迎接新世纪文明的太阳。

1999 年 8 月 北京



PREFACE TO THE LIBRARY OF CHINESE CLASSICS

Yang Muzhi

The publication of the *Library of Chinese Classics* is a matter of great satisfaction to all of us who have been involved in the production of this monumental work. At the same time, we feel a weighty sense of responsibility, and take this opportunity to explain to our readers the motivation for undertaking this cross-century task.

1

The Chinese nation has a long history and a glorious culture, and it has been the aspiration of several generations of Chinese scholars to translate, edit and publish the whole corpus of the Chinese literary classics so that the nation's greatest cultural achievements can be introduced to people all over the world. There have been many translations of the Chinese classics done by foreign scholars. A few dozen years ago, a Western scholar translated the title of *A Dream of Red Mansions* into "A Dream of Red Chambers" and Lin Daiyu, the heroine in the novel, into "Black Jade." But while their endeavours have been laudable, the results of their labours have been less than satisfactory. Lack of knowledge of Chinese culture and an inadequate grasp of the Chinese written language have led the translators into many errors. As a consequence, not only are Chinese classical writings widely misunderstood in the rest of the world, in some cases their content has actually been distorted. At one time, there was a "Jin Ping Mei craze" among Western scholars, who thought that they had uncovered a miraculous phenomenon, and published theories claiming that China was the "fountainhead of eroticism," and that a Chinese "tradition of permissiveness" was about to be laid bare. This distorted view came about due to the translators of the *Jin Ping Mei* (*Plum in the Golden Vase*) putting one-sided stress on the



raw elements in that novel, to the neglect of its overall literary value. Meanwhile, there have been many distinguished and well-intentioned Sinologists who have attempted to make the culture of the Chinese nation more widely known by translating works of ancient Chinese philosophy. However, the quality of such work, in many cases, is unsatisfactory, often missing the point entirely. The great philosopher Hegel considered that ancient China had no philosophy in the real sense of the word, being stuck in philosophical “prehistory.” For such an eminent authority to make such a colossal error of judgment is truly regrettable. But, of course, Hegel was just as subject to the constraints of time, space and other objective conditions as anyone else, and since he had to rely for his knowledge of Chinese philosophy on inadequate translations it is not difficult to imagine why he went so far off the mark.

China cannot be separated from the rest of the world; and the rest of the world cannot ignore China. Throughout its history, Chinese civilization has enriched itself by absorbing new elements from the outside world, and in turn has contributed to the progress of world civilization as a whole by transmitting to other peoples its own cultural achievements. From the 5th to the 15th centuries, China marched in the front ranks of world civilization. If mankind wishes to advance, how can it afford to ignore China? How can it afford not to make a thoroughgoing study of its history?

2

Despite the ups and downs in their fortunes, the Chinese people have always been idealistic, and have never ceased to forge ahead and learn from others, eager to strengthen ties of peace and friendship.

The great ancient Chinese philosopher Confucius once said, “Wherever three persons come together, one of them will surely be able to teach me something. I will pick out his good points and emulate them; his bad points I will reform.” Confucius meant by this that we should always be ready to learn from others. This maxim encapsulates the principle the Chinese people have always followed in their dealings with other peoples, not only on an individual basis but also at the level of state-to-state relations.

After generations of internecine strife, China was unified by Emperor



Qin Shi Huang (the First Emperor of the Qin Dynasty) in 221 B.C. The Han Dynasty, which succeeded that of the short-lived Qin, waxed powerful, and for the first time brought China into contact with the outside world. In 138 B.C., Emperor Wu dispatched Zhang Qian to the western regions, i.e. Central Asia. Zhang, who traveled as far as what is now Iran, took with him as presents for the rulers he visited on the way 10,000 head of sheep and cattle, as well as gold and silks worth a fabulous amount. In 73 D.C., Ban Chao headed a 36-man legation to the western regions. These were missions of friendship to visit neighbours the Chinese people had never met before and to learn from them. Ban Chao sent Gan Ying to explore further toward the west. According to the "Western Regions Section" in the *Book of Later Han*, Gan Ying traveled across the territories of present-day Iraq and Syria, and reached the Mediterranean Sea, an expedition which brought him within the confines of the Roman Empire. Later, during the Tang Dynasty, the monk Xuan Zang made a journey fraught with danger to reach India and seek the knowledge of that land. Upon his return, he organized a team of scholars to translate the Buddhist scriptures, which he had brought back with him. As a result, many of these scriptural classics which were later lost in India have been preserved in China. In fact, it would have been difficult for the people of India to reconstruct their own ancient history if it had not been for Xuan Zang's *A Record of a Journey to the West in the Time of the Great Tang Dynasty*. In the Ming Dynasty, Zheng He transmitted Chinese culture to Southeast Asia during his seven voyages. Following the Opium Wars in the mid-19th century, progressive Chinese, generation after generation, went to study the advanced scientific thought and cultural achievements of the Western countries. Their aim was to revive the fortunes of their own country. Among them were people who were later to become leaders of China, including Zhu De, Zhou Enlai and Deng Xiaoping. In addition, there were people who were to become leading scientists, literary figures and artists, such as Guo Moruo, Li Siguang, Qian Xuesen, Xián Xinghai and Xu Beihong. Their spirit of ambition, their struggles and their breadth of vision were an inspiration not only to the Chinese people but to people all over the world.

Indeed, it is true that if the Chinese people had not learned many



things from the surrounding countries they would never have been able to produce the splendid achievements of former days. When we look back upon history, how can we not feel profoundly grateful for the legacies of the civilizations of ancient Egypt, Greece and India? How can we not feel fondness and respect for the cultures of Europe, Africa, America and Oceania?

The Chinese nation, in turn, has made unique contributions to the community of mankind. Prior to the 15th century, China led the world in science and technology. The British scientist Joseph Needham once said, "From the third century A.D. to the 13th century A.D. China was far ahead of the West in the level of its scientific knowledge." Paul Kennedy, of Yale University in the U.S., author of *The Rise and Fall of the Great Powers*, said, "Of all the civilizations of the pre-modern period, none was as well-developed or as progressive as that of China."

Foreigners who came to China were often astonished at what they saw and heard. The Greek geographer Pausanias in the second century A.D. gave the first account in the West of the technique of silk production in China: "The Chinese feed a spider-like insect with millet and reeds. After five years the insect's stomach splits open, and silk is extracted therefrom." From this extract, we can see that the Europeans at that time did not know the art of silk manufacture. In the middle of the 9th century A.D., an Arabian writer includes the following anecdote in his *Account of China and India*:

"One day, an Arabian merchant called upon the military governor of Guangzhou. Throughout the meeting, the visitor could not keep his eyes off the governor's chest. Noticing this, the latter asked the Arab merchant what he was staring at. The merchant replied, 'Through the silk robe you are wearing, I can faintly see a black mole on your chest. Your robe must be made out of very fine silk indeed!' The governor burst out laughing, and holding out his sleeve invited the merchant to count how many garments he was wearing. The merchant did so, and discovered that the governor was actually wearing five silk robes, one on top of the other, and they were made of such fine material that a tiny mole could be seen through them all! Moreover, the governor explained that the robes he was wearing were not made of the finest silk at all; silk of the highest



grade was reserved for the garments worn by the provincial governor.”

The references to tea in this book (the author calls it “dried grass”) reveal that the custom of drinking tea was unknown in the Arab countries at that time: “The king of China’s revenue comes mainly from taxes on salt and the dry leaves of a kind of grass which is drunk after boiled water is poured on it. This dried grass is sold at a high price in every city in the country. The Chinese call it ‘cha.’ The bush is like alfalfa, except that it bears more leaves, which are also more fragrant than alfalfa. It has a slightly bitter taste, and when it is infused in boiling water it is said to have medicinal properties.”

Foreign visitors showed especial admiration for Chinese medicine. One wrote, “China has very good medical conditions. Poor people are given money to buy medicines by the government.”

In this period, when Chinese culture was in full bloom, scholars flocked from all over the world to China for sightseeing and for study. Chang’an, the capital of the Tang Dynasty was host to visitors from as far away as the Byzantine Empire, not to mention the neighboring countries of Asia. Chang’an, at that time the world’s greatest metropolis, was packed with thousands of foreign dignitaries, students, diplomats, merchants, artisans and entertainers. Japan especially sent contingent after contingent of envoys to the Tang court. Worthy of note are the accounts of life in Chang’an written by Abeno Nakamaro, a Japanese scholar who studied in China and had close friendships with ministers of the Tang court and many Chinese scholars in a period of over 50 years. The description throws light on the exchanges between Chinese and foreigners in this period. When Abeno was supposedly lost at sea on his way back home, the leading poet of the time, Li Bai, wrote a eulogy for him.

The following centuries saw a steady increase in the accounts of China written by Western visitors. The Italian Marco Polo described conditions in China during the Yuan Dynasty in his *Travels*. However, until advances in the science of navigation led to the opening of east-west shipping routes at the beginning of the 16th century Sino-Western cultural exchanges were coloured by fantasy and conjecture. Concrete progress was made when a contingent of religious missionaries, men well versed in Western science and technology, made their way to China, ushering in an era of



direct contacts between China and the West. The experience of this era was embodied in the career of the Italian Jesuit Matteo Ricci. Arriving in China in 1582, Ricci died in Beijing in 1610. Apart from his missionary work, Ricci accomplished two historically symbolic tasks — one was the translation into Latin of the “Four Books,” together with annotations, in 1594; the other was the translation into Chinese of Euclid’s *Elements*.

The rough translations of the “Four Books” and other Chinese classical works by Western missionaries, and the publication of Père du Halde’s *Description Geographique, Historique, Chronologique, Politique, et Physique de l’Empire de la Chine* revealed an exotic culture to Western readers, and sparked a “China fever,” during which the eyes of many Western intellectuals were fixed on China. Some of these intellectuals, including Leibniz, held China in high esteem; others, such as Hegel, nursed a critical attitude toward Chinese culture. Leibniz considered that some aspects of Chinese thought were close to his own views, such as the philosophy of the *Book of Changes* and his own binary system. Hegel, on the other hand, as mentioned above, considered that China had developed no proper philosophy of its own. Nevertheless, no matter whether the reaction was one of admiration, criticism, acceptance or rejection, Sino-Western exchanges were of great significance. The transmission of advanced Chinese science and technology to the West, especially the Chinese inventions of paper-making, gunpowder, printing and the compass, greatly changed the face of the whole world. Karl Marx said, “Chinese gunpowder blew the feudal class of knights to smithereens; the compass opened up world markets and built colonies; and printing became an implement of Protestantism and the most powerful lever and necessary precondition for intellectual development and creation.” The English philosopher Roger Bacon said that China’s four great inventions had “changed the face of the whole world and the state of affairs of everything.”

3

Ancient China gave birth to a large number of eminent scientists, such as Zu Chongzhi, Li Shizhen, Sun Simiao, Zhang Heng, Shen Kuo and Bi



Sheng. They produced numerous treatises on scientific subjects, including *The Manual of Important Arts for the People's Welfare*, *Nine Chapters on the Mathematical Art*, *A Treatise on Febrile Diseases* and *Compendium of Materia Medica*. Their accomplishments included ones whose influence has been felt right down to modern times, such as the armillary sphere, seismograph, Dujiangyan water conservancy project, Dunhuang Grottoes, Grand Canal and Great Wall. But from the latter part of the 15th century, and for the next 400 years, Europe gradually became the cultural centre upon which the world's eyes were fixed. The world's most outstanding scientists then were England's Isaac Newton, Poland's Copernicus, France's Marie Curie, Germany's Rontgen and Einstein, Italy's Galileo, Russia's Mendeleev and America's Edison.

The Chinese people then began to think: What is the cause of the rise and fall of nations? Moreover, how did it happen that gunpowder, invented in China and transmitted to the West, in no time at all made Europe powerful enough to batter down the gates of China herself?

It took the Opium War to wake China from its reverie. The first generation to make the bold step of "turning our eyes once again to the rest of the world" was represented by Lin Zexu and Wei Yuan. Zeng Guofan and Li Hongzhang started the Westernization Movement, and later intellectuals raised the slogan of "Democracy and Science." Noble-minded patriots, realizing that China had fallen behind in the race for modernization, set out on a painful quest. But in backwardness lay the motivation for change, and the quest produced the embryo of a towering hope, and the Chinese people finally gathered under a banner proclaiming a "March Toward Science."

On the threshold of the 21st century, the world is moving in the direction of becoming an integrated entity. This trend is becoming clearer by the day. In fact, the history of the various peoples of the world is also becoming the history of mankind as a whole. Today, it is impossible for any nation's culture to develop without absorbing the excellent aspects of the cultures of other peoples. When Western culture absorbs aspects of Chinese culture, this is not just because it has come into contact with Chinese culture, but also because of the active creativity and development of Western culture itself; and vice versa. The various cultures of



the world's peoples are a precious heritage which we all share. Mankind no longer lives on different continents, but on one big continent, or in a "global village." And so, in this era characterized by an all-encompassing network of knowledge and information we should learn from each other and march in step along the highway of development to construct a brand-new "global village."

Western learning is still being transmitted to the East, and vice versa. China is accelerating its pace of absorption of the best parts of the cultures of other countries, and there is no doubt that both the West and the East need the nourishment of Chinese culture. Based on this recognition, we have edited and published the *Library of Chinese Classics* in a Chinese-English format as an introduction to the corpus of traditional Chinese culture in a comprehensive and systematic translation. Through this collection, our aim is to reveal to the world the aspirations and dreams of the Chinese people over the past 5,000 years and the splendour of the new historical era in China. Like a phoenix rising from the ashes, the Chinese people in unison are welcoming the cultural sunrise of the new century.

August 1999



前言

17 世纪，欧洲进入历史大变革时代，资本主义正在兴起；在中国，资本主义也开始萌芽，农业和手工业等生产技术全面提高。在这个集传统科技之大成而又充满新气息的时代，明朝中后期出现了一批反映中国古代科技成就的巨著，宋应星著的《天工开物》便是其中的杰出代表。

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宋应星（1587—约 1666），字长庚，明朝后期出生于江西省奉新县。宋应星自幼聪颖好学，记忆力过人，不及十岁便会作诗。他博览群书，兴趣广泛，十三经传、宋代理学、历史乃至诸子百家均有涉猎，对音乐、天文、医药、弈棋、绘画以及自然科学亦十分喜爱。

1616~1631 年间，宋应星多次远游应试科举，均落第而归。科举及第的目标虽未实现，长途旅行却打开了眼界，增长了社会见闻。宋应星的足迹遍及京师、江西、湖北、安徽、江苏、山东、河南、河北、浙江等省的许多城市和乡村。沿途他在田间、作坊调查到不少农业和手工业的技术知识、操作过程，并对操作实态作了素描，记下不少笔记，为日后撰写《天工开物》积累了第一手资料。

对科举绝望后，宋应星便决心转向实学，研究与国计民生直接关联的科技问题。1634 年，宋应星出任江西省分宜县教谕。教谕任期内，有更多的闲散时间，他便抓紧时机整理资料，从事著述。1636 年，刊印《画音归正》、《原耗》、《野议》、《思怜诗》等书，1637 年，著成代表作《天工开物》，以及《卮言十种》，内容涉及科技、政治、经济、哲学、文学等方面。

二

《天工开物》是中国古代百科全书式的科技著作，论述了农业和手工业两大领域内 30 个生产部门的技术，分上中下三卷，共 18 章，插图 123 幅。每章首有“宋子曰”一段作为引言，对全章内容作提要性叙述。上卷主要记述谷物栽培及农具、水利机械，养蚕与丝织技术，植物染料与染色技术，制盐技术与工具，甘蔗种植与制糖技术。中卷记述砖、瓦及白瓷的烧炼技术，冶炼与铸造技术，舟车结构与使用方法，锻造铁器的工艺，烧制石灰、采煤等技术，植物油脂提炼工艺，造纸技术。下卷记述金银等各种金属矿石的开采与冶炼技术，冷兵器的制造工艺，朱砂研制，制墨，酒曲制造，珍珠、宝石等的开采工艺等。

宋应星具有与欧洲同时代的科学家伽利略 (G. Galilei)、维萨里乌斯 (A. Vesalius) 和阿格里柯拉 (G. Agricola) 等类似的气质，多才多艺、学识渊博，他有长途旅行的经历，对各种错误观念持批判态度，注重实践并基于自身观察、调查和试验从事写作。由于宋应星独特的学术视野与人生经历，较之此前的同类著作，《天工开物》至少具有以下几个特点。

第一，《天工开物》不是历代文献的堆积，而是据生产现场的实地调查著述而成。宋应星通过实地调查，详细记述了工农业生产领域的技术过程、操作要点、原料及产品、生产工具，以及先进的科技成果。除了文字表述，还用插图将生产情景再现出来。比如，金属与合金冶炼是重要的工业技术，其中不少技术是中国人民的创造发明，如灌钢、以煤炼铁、直接将生铁炒成熟铁、用大型活塞风箱鼓风，以及分金炉、大型反射式炼炉等，但过去著作却少有系统而详细的记录，《天工开物》第一次详细地记录下了这些技术的操作细节和所用工具的秘密，并附有珍贵的工艺图。

第二，《天工开物》是在一种先进而又有特色的技术哲学思想的指导下写成的，我们将其概括为“天工开物思想”。这种思想强调人与天相协调、人工（人力）与天工（自然力）相配合，通





过技术从自然界中开发出有用之物。《膏液》中的一段话最能表述其思想内核：“草木之实，其中蕴藏膏液，而不能自流。假媒水火，凭借木石，而后倾注而出焉。此人巧聪明……”整个人类文明史表明，人与自然界相协调、人力与自然力相配合，通过人的技术技巧不断从自然界开发有用之物，对促进物质生产、发展文化、保持生态平衡具有重要意义。如果违背，便会产生恶果。正是《天工开物》，第一个表述了这种优秀的哲学思想。

第三，《天工开物》对原料与能源的消耗、成品产率、设备构造及各部件尺寸等等，都尽可能给以定量的描述，且绘出工艺操作图，在某种程度上好像是近代科学家对传统技术写出的调查报告。西方近代科学以其数学化而与中世纪诀别，《天工开物》在这方面走得相当远。生产过程中涉及的长宽高、重量、容积、比率、时间等技术指标都作了描述，其中长度精密到分寸、重量精密到钱这样的数量级。书中的大量设备图有立体感，各部件长短协调，有如工程画；画面上人物操作逼真、表情自然，联起来好像中国古代技术史的长卷画面。三百多年前能出现这样一部科技著作，确实令人赞叹。

总之，《天工开物》被称为 17 世纪中国的技术百科全书，是当之无愧的。

三

1637 年，在老友涂绍煊的资助下，《天工开物》初刻本（简称涂本）在南昌出版。自清初杨素卿刊刻第二版（简称杨本）后，《天工开物》又在清代流传二百多年，为中国社会提供了一部标准的科技读物，成为人们获得有关工农业技术知识的渊薮。

《天工开物》在国外也同样产生了良好影响。

17 世纪末，《天工开物》由商船带到日本，本草学家贝原笃信首先在其著作《大和本草》中引用此书。18 世纪，汉文原著继续传到日本，引起日本学者的广泛重视，并出现了不少传抄本，其中木村孔恭的兼葭堂抄本较为著名。明和八年，大阪的菅生堂刊行和刻本，从此《天工开物》便在日本广泛传播开来。这是



《天工开物》在国外刊行的第一个版本。《天工开物》还影响到日本思想界，18世纪，日本哲学和经济学界兴起了“开物之学”。日本科学史家薮内清说：“整个德川时代读过这部书的人是很多的，特别是关于技术方面，成为一般学者的优秀参考书。”

18世纪，《天工开物》也引起了朝鲜学者的重视，学者朴趾源赞赏《天工开物》中所载灌溉水车，希望本国加以仿制。此后不久，汉文原著陆续传到朝鲜，为朝鲜学者所广泛引用，比如，李圭景在《五洲衍文长笺散稿》等书中反复引用《天工开物》特别是其中关于金属及铜合金冶炼方面的技术。

18世纪，《天工开物》也传到了欧洲，首先是法国，巴黎的国家图书馆藏有涂本和杨本两种版本，欧洲其他国家的大图书馆也有藏本。由于是汉文书，直到19世纪上半叶，此书的价值才被发现。1830年，汉学家儒莲（Stanislas Julien）将《丹青》章关于银朱的部分译成法文，发表于《新亚洲报》（Nouveau Journal Asiatique）。这可能是《天工开物》被译成欧洲文的开始。1830~1840年间，儒莲先后将《丹青》、《五金》、《乃服》、《彰施》及《杀青》等的部分内容摘译成法文，有的译文再转为英文、德文、意大利文和俄文。《天工开物》中关于银朱、养蚕、染料、造纸、铜合金等方面的技术引起了欧洲科技界的兴趣。1869年，儒莲又与科学家商毕昂（Paul Champion）合作用法文发表《中华帝国工业之今昔》（Industries Anciennes et Modernes de l'Empire Chinois），将《作咸》、《陶埏》、《冶铸》、《锤锻》、《燔石》、《杀青》、《五金》及《丹青》等工艺部分摘译出来。儒莲的这些工作，为中西科学文化交流作出了贡献。达尔文读过儒莲译的《天工开物》论养蚕部分的译著后，称之为“权威著作”。

20世纪以降，《天工开物》继续受到世界学术界的重视。1952年，薮内清主持将《天工开物》全文译成日文。1964年，柏林学者蒂洛（Thomas Thilo）将《乃粒》、《乃服》、《彰施》、《粹精》全文译成德文。1966年，美国匹兹堡的任以都将全书译成英文。1980年，李乔苹主持的另一个英译本在中国台北出版。1993年，汉城外国语大学的崔炷译注的韩文本出版。



目前《天工开物》已成为世界科技名著在各国流传，凡研究中国科学文化史的，无不引用此书，且都给予高度评价，认为它是了解中国古代社会实态和传统科技的一把钥匙。法国的儒莲和巴参 (M.Bazin) 将此书称为“技术百科全书”或“实用小百科全书”。日本的三枝博音和蕞内清将此书视为“中国有代表性的技术书”和“足以与 18 世纪后半期法国狄德罗编纂的《百科全书》相匹敌的书籍”。英国的李约瑟 (Joseph Needham) 将《天工开物》与西方文艺复兴的技术经典阿格里柯拉的《矿冶全书》(De re Metallica) 相比，称宋应星为“中国的阿格里柯拉”。

潘吉星

2009 年 10 月



Introduction

In the seventeenth century, Europe witnessed a great historical change and capitalism began flourishing there, while in China, capitalism just began to appear and the manufacturing techniques in agriculture and handicrafts had been improved a great deal. In the era when the traditional techniques and new technologies co-existed, there appeared some works which reflected the ancient Chinese technological achievements in the mid and late Ming Dynasty. Song Yingxing's works *Tian Gong Kai Wu* was an outstanding masterpiece among them.

I

Song Yingxing (born in 1587 and died approximately in 1666), styled himself Changgeng, was a native of Fengxin County, Jiangxi Province living in the late Ming Dynasty. In childhood, he already showed his talent and his eagerness to learn. He had a very good memory and could write poems when he was less than ten years old. He had a wide range of interest and read extensively, including such books as the *Thirteen Confucian Classics*, Philosophy of the Song Dynasty, history books and books on different schools of thought. In addition, he was fond of music, astronomy, medicine, games of chess, painting and natural science.

Between 1616 and 1631, Song Yingxing travelled very long distances to take the imperial public examinations many times, but unfortunately he failed in each examination. Although he was not



successful in these examinations and did not achieve his goal, the experience of the long travels broadened his horizon and enriched his social experience and knowledge. Song Yingxing, on his journey to the capital, travelled to many cities and rural areas in many provinces such as Jiangxi, Hubei, Anhui, Jiangsu, Shandong, Henan, Hebei and Zhejiang. In the course of travelling up north, he visited the fields and workshops for the purpose of accumulating knowledge about agriculture, handicrafts and the operational processes. He also made plentiful sketches of the actual operational processes and took many notes. All this enabled him to acquire firsthand materials for the writing of his works *Tian Gong Kai Wu*.

Disillusioned with the imperial public examinations, Song Yingxing was determined to shift his attention to the study of industrial and technological matters concerning the livelihood of the general public. In 1634, he took up a post as the Education Officer in Fenyi County, Jiangxi Province. During his term of service, he spent a lot of time collecting information and materials which helped him in writing his books. In 1636, he published *On Phonology* and *Music Theory*, *Social Criticism* and *Thoughts on Reforms*, *A Collection of 32 Poems*, etc. In 1637, he published his masterpiece *Tian Gong Kai Wu*, and *Ten Writings on Natural Science*, which were mainly concerned with science and technology, politics, economics, philosophy and literature.

II

Tian Gong Kai Wu is an ancient Chinese encyclopedia in science and technology. It involves two major fields—agriculture and handicrafts. It can be divided into three parts, consisting of 18 chapters, along with 123 figures and illustrations. Every chapter begins with the



words “Songzi says” which introduces the major contents of each chapter. Volume I discusses such topics as grain cultivation and farming tools, water conservancy machinery, salt making and the tools used, sugar cane plantation and sugar making, oil and fat refining, silkworm raising and silk making, dyestuff and dye making. Volume II mainly discusses the techniques of metallurgy and casting, the mining of gold and silver and other metal ores and the smelting techniques, the arts and techniques of forging iron and metal articles, methods of making bricks and tiles, and the calcination of stones, sulphur and the mining of coal. Volume III focuses on techniques of paper making, cinnabar refining and ink making, structuring boats and carts and the methods of using them, the methods of making gunpowder and incendiary weapons, yeast making and the mining of pearls and gems.

Having the qualities of the scientists of his time in Europe, such as G. Galilei, A. Vesalius and G. Agricola. Song Yingxing was a versatile scientist profound in knowledge. He had the experience of long distance travels and critical attitude towards various types of misconceptions. Being practice-oriented, he based his writings on his own observations, investigations and experiments. Because of his unique academic insights, world outlook and personal experience, *Tian Gong Kai Wu* had the following features compared with other works of the same kind.

First of all, *Tian Gong Kai Wu* was not simply an accumulation of different historical documents related. On the contrary, it was written in accordance with Song Yingxing’s on-the-spot investigations. Therefore, Song Yingxing described in detail the manufacturing processes, the essentials of operation, raw materials, products and tools of production in relation to industry and agriculture, and meanwhile he



records in his book the advanced technological achievements of his day. In addition to verbal description, he provides various kinds of illustrations to show vividly the manufacturing procedures. A good case in point was the smelting of metal with alloy, which was one of the important industrial techniques of the time, and factually much of it was the Chinese invention and application—smelting iron with coal, converting pig iron into wrought iron, using large bellow piston drum machines and the gold furnace to name just a few. But the works prior to this failed to record these techniques in detail or in a systematic manner. *Tian Gong Kai Wu* gave a detailed account of the operational procedures of these techniques and the tools used for the first time, supported by valuable flow charts. Secondly, *Tian Gong Kai Wu* was written in the light of advanced and distinctive technological achievements, which was considered as “the concept of writing *Tian Gong Kai Wu*”. The Chinese philosophy was that man and universe were to harmonize, and man’s capacity and the nature’s might were to unite. By utilizing technology, man could create useful things from the nature. A segment of writing in the chapter of Oil and Fat Making can best illustrate the above philosophy: when people do something to the seeds of grasses and trees with the help of the forces of water and fire and the pressure of wooden and stone utensils, the oil will come out. So the people who can do this are smart indeed. The history of human civilization showed that the age-old Chinese philosophy could promote the production of materials, develop human culture and maintain ecological balance. Without obeying these philosophical teachings, undesirable consequences would result.

Tian Gong Kai Wu was the very first works to reveal this divine philosophy.



Thirdly, *Tian Gong Kai Wu* depicts, in a quantitative manner, the consumption of raw materials and energy, the productivities of the finished products, the structures of equipment and so on; meanwhile, the book provides some flow charts, which, to a certain extent, resemble the written reports of findings in traditional technology given by scientists in modern times. With the introduction of mathematization, modern science in the west bid farewell to the Middle Ages, but *Tian Gong Kai Wu* achieved the goal of mathematization much earlier. It records, in detail, the technical specifications concerning the length, width, height, weight, volume, rate and timing; and the precision of length and weight is measured in *cun* and *qian* respectively, which are the smallest units both in measuring length and weight. *Tian Gong Kai Wu* contained a large number of vivid charts of equipment and all the parts are proportionately structured so that they look like engineering drawings. The people in the pictures are just like the real ones with natural expressions. If these pictures are connected and put together, one after another, they would become picture scrolls of ancient Chinese history of technology. Everyone would marvel at such a great work of science and technology.

In short, *Tian Gong Kai Wu* well deserves the title of the Chinese technological encyclopedia in the seventeenth century.

III

In 1637, with the help of his old friend Tu Shaokui, the first edition of *Tian Gong Kai Wu* (Tu's version for short) was published in Nanchang, Jiangxi Province. Since the second edition was published by Yang Suqing in the early Qing Dynasty (Yang's version for short), *Tian Gong Kai Wu* had been circulating for over two hundred years in the



Qing Dynasty. It was a standardized technological book for the Chinese readers and became a resource book for those who wanted to learn about industrial and agricultural techniques.

Tian Gong Kai Wu was also well received by the Western readership. At the end of the seventeenth century, *Tian Gong Kai Wu* was transmitted to Japan by a merchant ship. The Japanese scholar Ekiken Kaibara first cited this book in his Japanese work *Materia Medica*. In the eighteenth century, some copies of this original Chinese work continued to be transmitted to Japan, and aroused greater interest among the Japanese scholars. Then there appeared many private copies of the manuscript. In the eighth year of Meiwa, Sugao Church in Osaka published this book. From then on, *Tian Gong Kai Wu* was widely spread in Japan. And this was the first version published abroad. *Tian Gong Kai Wu* also influenced the ideology in Japan. In the eighteenth century, there appeared a movement to learn and read *Tian Gong Kai Wu*. Yabuuchi Kiyoshi, a Japanese scholar in history of science commented, "There were many people in Tokugawa period who read this book, particularly the writings on techniques. This book was regarded as an excellent reference book for the general readers."

In the eighteenth century, *Tian Gong Kai Wu* also drew the attention of some Korean scholars. Pak Chi-Won spoke highly of the irrigating water cart in *Tian Gong Kai Wu* and suggested that his country replicate it. Soon afterwards, some original Chinese works continued to be transmitted to Korea, and were extensively cited by Korean scholars. For instance, Lee Feng-jing quoted *Tian Gong Kai Wu*, especially the techniques about metallurgy of metal and copper and gold alloy in some of his books.

In the eighteenth century, *Tian Gong Kai Wu* was transmitted to



Europe. The French National Library in Paris first housed the two versions of the book — Tu's version and Yang's version, and then other national libraries in Europe also added this book to their collection. Due to the fact that it was written in Chinese, it was not until the first half of the nineteenth century that the real value of the book was fully realized. In 1830, Sinologist Stanislas Julien translated the section about mercuric cinnabar in the chapter of Cinnabar and Ink into French and published it in *Nouveau Journal Asiatique*. This probably was the beginning of the translation of *Tian Gong Kai Wu* into other European languages. Between 1830 and 1840, Julien first translated into French some chapters, including Metallurgy, Clothing Materials, Dyes and Paper Making, and then translated the French version of the book into English, German, Italian and Russian. The technologies about mercuric cinnabar, silkworm raising, dyes, paper making and metallurgy in *Tian Gong Kai Wu* aroused great interest in the European world of science and technology. In 1869, Julien, together with a scientist named Paul Champion, published *Industries Anciennes et Modernes de L'Empire Chinois* in French. They translated Salt Making, Ceramics, Casting, Forging, Calcination of Stones, Paper Making, Metallurgy and Cinnabar and Ink into French. Through doing all these work Julien made a great contribution to the communication and exchange of Chinese and Western science and culture. After reading Julien's translation on Silkworm Raising in *Tian Gong Kai Wu*, the celebrated naturalist Charles Darwin labeled Song Yingxing's book as "Works of Authority".

Since the beginning of the twentieth century, *Tian Gong Kai Wu* has been drawing increasing attention from the academia. In 1952, Yabuuchi Kiyoshi took charge of the translation of *Tian Gong Kai Wu*



into Japanese. In 1964, Thomas Thilo, a Berlin scholar, translated such chapters as the Cultivation of Grains, Clothing Materials, Dyes, and Rice and Wheat of the book into German. In 1966, Ren Yidu from Pittsburgh, USA, translated the whole book into English. In 1980, Li Qiaoping translated it into another English version and published it in Taipei, China. In 1993, Cui Zhu, from University of Foreign Languages, in Seoul, translated and published it in Korean.

At present, *Tian Gong Kai Wu* has become a masterpiece of world science and technology and has been circulating all over the world. Those who study the history of Chinese technology all make reference to the book. They view it as a reference book and speak highly of it. They all consider it as a key to a better understanding of the ancient Chinese society and traditional science and technology. Julien and M. Bazin in France call it “An Encyclopedia of Technology” or “A Practical Mini-encyclopedia.” Japanese scholars such as Yabuuchi Kiyoshi regard this book as the “representative book on Chinese technology” and “It can well match the encyclopedia compiled by Diderot in France in the latter half of the eighteenth century.” Joseph Needham in Britain compared an *Tian Gong Kai Wu* to G.Agricola’s technological classic works *Dere Metallica*, a book during the Renaissance, and called Mr. Song Yingxing “the Agricola in China”.

Pan Jixing

October, 2009

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宋应星 (1587—约 1666)

Song Yingxing (1587—c.1666)



天工开物·卷上

乃粒第一

【原文】

宋子曰，上古神农氏若存若亡，然味其徽号，两言至今存矣。生人不能久生，而五谷生之。五谷不能自生，而生人生之。土脉历时代而异，种性随水土而分。不然，神农去陶唐粒食已千年矣，耒耜之利，以教天下，岂有隐焉。而纷纷嘉种必待后稷详明，其故何也？

纨绔之子以赭衣视笠蓑，经生之家以农夫为诟詈。晨炊晚饷，知其味而忘其源者众矣。夫先农而系之以神，岂人力之所为哉。

总名

凡谷无定名，百谷指成数言。五谷则麻、菽、麦、稷、黍，独

【今译】

宋子说，不管上古时的神农氏是否真有其人，然而体会到这一称号的含义，也应当把创始农业的先民尊称为“神农”。人不能靠自身长期生存，要靠五谷才能活下去。五谷不能自行生长，要靠人去种植。土质经历不同时代而发生变化，作物的物种和性质则随着水土的不同而有所变异。不然的话，从神农氏到帝尧时食用粮食已有一千年了，农耕的技术已传遍天下，尽人皆知，一定要到后稷时代才能充分阐明那些后来培育出的许多优良品种，原因不正是如此吗？

富贵人家的子弟把农民视同罪人，儒生之家把“农夫”当作骂人话。饱食终日，只贪享食物的美味而忘掉其从何而来的人，实在是太多了。因此我们认为把创始农业的先农们的事业奉为神圣的事业，并不是勉强的，而是很自然的。

总名

谷并不指某种特定的粮食名称，百谷是谷物的总体名称。而五谷



Volume I

Chapter 1

Cultivation of Grains

Songzi says that we should respect the legendary farmers of antiquity (known as the Divine Agriculturists) who first developed agriculture even though it still remains unknown whether or not those people existed in history. Man cannot survive by himself but must rely on the five grains. The five grains cannot grow out of the ground naturally by themselves, but have to be planted by man. The soil changes as time passes by and as a result the varieties and the nature of crops changes due to the changes of the soil. Otherwise, the first cultivation of edible crops has a history of over one thousand years if we trace it back to the time of the Divine Agriculturalist and the semi-legendary Emperor Tao-tang and the farming techniques would be widely known to all. It was not until the time of Houji that the new varieties of crops are recorded in detail.

The offsprings of aristocrats regarded farmers as convicts, and the scholarly families used the word "farmer" as a curse word. These people have abundant food supply and enjoy the good taste of their food, but are very ignorant of the food sources. Therefore, it is natural and reasonable to regard the agriculture first developed by the legendary farmers as a divine cause.

General Terms

The term "grain" does not refer to a specific type of crop, but is a general term for "as many as a hundred crops," while "the five grains"



【原文】

遗稻者，以著书圣贤起自西北也。今天下育民人者，稻居十七，而来、牟、黍、稷居十三。麻、菽二者，功用已全入蔬、饵、膏饌之中，而犹系之谷者，从其朔也。

稻

凡稻种最多。不黏者禾曰秔，米曰粳。黏者禾曰秣，米曰糯。（南方无黏黍，酒皆糯米所为。）质本粳而晚收带黏（俗名婺源光之类），不可为酒只可为粥者，又一种性也。凡稻谷形有长芒、短芒、长粒、尖粒、圆顶、扁面不一。其中米色有雪白、牙黄、大赤、半紫、杂黑不一。

湿种之期，最早者春分以前，名为社种（遇天寒有冻死不生者），最迟者后于清明。凡播种，先以稻、麦稿包浸数日。俟其生芽，撒于

【今译】

则指麻、豆、麦、稷、黍，唯独漏掉了稻，这是因为称呼五谷的一些著书的圣贤都诞生在西北。但现在全国民用的口粮中，稻占十分之七，而小麦、大麦、黍、稷只占十分之三。麻、豆二者的功用现已完全列入菜蔬、糕点、油脂等食品中，其所以还归到五谷里，是沿用早期的说法。

稻

水稻的品种最多。不黏的稻叫秔稻，米叫粳米。黏的稻叫秣稻，米叫糯米。（南方没有黏黄米，酒都是用糯米造的。）本来属于粳稻但晚熟而带黏性的米（俗名为“婺源光”一类的），不能用来造酒，而只可以煮粥，这又是一种稻。稻谷在外形来看，有长芒、短芒和长粒、尖粒以及圆顶、扁粒的不同。其中稻米的颜色还有雪白、牙黄、大红、半紫和杂黑，等等。

浸稻种的日期，最早在春分以前，称为“社种”（这时遇到天寒，有冻死不生的），最晚是在清明以后。播种时，先用稻、麦秆包住种子



refer to sesamum, beans, wheat, panicum millet and glutinous millet. Rice is excluded because the ancient sages who wrote on the subject were all born in northwestern China. Nowadays rice constitutes seventy percent of the people's staple food, while wheat, barley and various kinds of millet constitute thirty percent. Although sesamum and beans were traditionally classified as grains, they are now used as vegetables and raw materials for making oil.

Rice

There are many types of rice. The non-glutinous kind is called round-grained non-glutinous rice, and the grain obtained from it is called polished round-grained non-glutinous rice. The glutinous kind is called glutinous rice, and the grain obtained from it is called polished glutinous rice. (Since no glutinous millet is grown in the south of the Yangze River, wine is made from glutinous rice.) Another kind of rice which originally belongs to the round-grained non-glutinous rice category ripens late and produces slightly glutinous grains (known as the rice produced in the town of Wuyuan in Jiangxi Province). It is not used to brew wine, but only used to cook porridge. The shapes of rice are different in different places, with the long-speared one and the short-speared one. The grains of rice vary from the long-grained to pointed-grained (people in the south call the long-speared rice "Liu Yang Early Season Rice" and the pointed-grained "Ji'an Early Season Rice"), or from the round-top rice to the flat-top rice, and so on. The colors of the grains of rice vary from snow-white, to ivory, red, semiviolet and dappled black.

At the earliest, the soaking of seed rice can be done before the Spring Equinox which is known as "*she* planting" (If there is a cold weather during this period of planting, the seeds will be frozen and can't grow out of the ground.), or can be done after Pure Brightness at the latest. The seed



【原文】

田中，生出寸许，其名曰秧。秧生三十日即拔起分栽。若田逢旱干、水溢，不可插秧。秧过期老而长节，即栽于亩中，生谷数粒，结果而已。凡秧田一亩所生秧，供移栽二十五亩。

凡秧既分栽后，早者七十日即收获（梗有救公饥、喉下急，糯有金包银之类。方语百千，不可殚述），最迟者历夏及冬二百日方收获。其冬季播种、仲夏即收者，则广南之稻，地无霜雪故也。凡稻旬日失水，即愁旱干。夏种秋收之谷，必山间源水不绝之亩，其谷种亦耐久，其土脉亦寒，不催苗也。湖滨之田待夏潦已过，六月方栽者。其秧立夏播种，撒藏高亩之上，以待时也。

南方平原，田多一岁两栽两获者。其再栽秧俗名晚糯，非梗类

【今译】

在水里浸几天。待生芽后撒播在田里，长到一寸左右高时叫做秧。稻秧长到三十天后就要拔起分栽。若稻田遇到干旱或积水过多，都不能插秧。育秧期已过而仍不插秧，秧就要老而长节，即使栽到田里也不过长几粒谷，不会再结更多谷实了。一亩秧田所育出的秧，可供移栽二十五亩。

稻秧分栽后，早熟的在七十天后即可收获（梗稻有“救公饥”、“喉下急”，糯稻有“金包银”等品种。各地名称很多，不可尽述），最晚熟的要经整夏直到冬天共二百多天后才能收获。有在冬季播种，到仲夏就能收获的，这就是广南地方的稻，因为此地没有霜雪。稻田十天无水，便有干旱之虞。夏种秋收的稻，必须种在有山间水源不断的田里，这种稻生长期长，地温又低，不能催苗速长。靠湖边的地要待夏天洪水过后，六月才能插秧。育这种秧的稻种要在立夏时撒播在地势高的田里，以待农时。

南方平原地区，多是一年两栽、两获。第二次插的秧俗名叫晚



rice is wrapped in rice or wheat straw and soaked for a few days. When the rice shoots appear, they are planted in the paddy fields. When the shoots are about one *cun* high, they are called “rice shoots”. One *mu* of rice shoots can provide rice plants for twenty-five *mu* of transplanted paddy fields. After growing for thirty days, the young plants are pulled out and transplanted. However, if the paddy fields are suffering from a drought or flood, transplanting is not done. If transplanting is done beyond the period of time required, the rice shoots will grow high and develop sections in their stalks. In this case the rice shoots will produce only a few grains of rice.

Seventy days after transplanting, the early-ripening rice can be harvested. (which includes both the non-glutinous and glutinous rice. The former is locally called “satisfying-one’s-hunger” and “ready-to-be-swallowed” and the latter is called “silver-wrapped-in-gold”. People in different places have different names for rice.) However, the late-ripening rice has to go through the entire summer so that it can be harvested in winter, two hundred days after transplanting. Due to the fact that there is neither frost nor snow in Guangdong Province, rice is planted in winter and harvested in mid-summer. The paddy fields will suffer from a drought if they are short of water for ten consecutive days. The rice that is planted in summer and harvested in winter must be planted in fields that are continuously fed by mountain streams. Due to the low temperature of the soil, this kind of rice has a longer period of growth, so it is not expected to grow fast. In the lake-side paddy fields, transplanting is not done until the sixth month of the solar calendar, after the summer floods are over. The seed rice for these rice shoots must be planted in the soil of higher fields to await the proper time of planting.

In the plains in southern China, rice is planted and harvested



【原文】

也。六月刈初禾，耕治老稿田，插再生秧。其秧清明时已偕早秧撒布。早秧一日无水即死，此秧历四五两月，任从烈日旱干无忧，此一异也。凡再植稻遇秋多晴，则汲灌与稻相终始。农家勤苦，为春酒之需也。凡稻旬日失水则死期至，幻出旱稻一种，梗而不黏者，即高山可插，又一异也。香稻一种，取其芳气，以供贵人，收实甚少，滋益全无，不足尚也。

稻 宜

凡稻，土脉焦枯则穗、实萧索。勤农粪田，多方以助之。人畜秽遗、榨油枯饼（枯者，以去膏而得名也。胡麻、菜蔬子为上，芸苔次之，大眼桐又次之，樟、柏、棉花又次之）、草皮、木叶以佐生机，普天之所同也。

【今译】

8

糯稻，不是粳稻之类。六月割早稻，翻耕稻茬田，再插晚稻秧。晚稻秧在清明时已和早稻秧同时播种。早稻秧一天无水即死，晚稻秧经四五两月，任从烈日暴晒和干旱也不怕，这是个奇怪的事。种晚稻遇到秋季晴天多的时候，则始终都要灌水。农家不惜勤苦，以满足用稻米造春酒的需要。稻要是十天缺水就要死，于是育出一种旱稻，属于粳稻但不带黏性，即使在高山地区也可插秧，这又是一种奇特的稻。还有一种香稻，只取其香味以供贵人。但结实甚少，滋养全无，不值得崇尚。

稻田土壤改良

种稻的土地要是贫瘠，稻穗、稻粒的长势就差。勤劳的农民便多施肥，想尽各种方法助苗成长。人、畜的粪便、榨油的枯饼（因其中油已榨去，故称枯饼。芝麻、萝卜子榨油后的枯饼最好，油菜子饼次之，大眼桐枯饼又次之，樟树子、乌柏子和棉子饼又次之），还有草皮、树叶，这些都



twice. The second crop is called late-ripening glutinous rice. It is not, however, the non-glutinous type of rice. After the early-ripening rice is harvested in the sixth month, the same paddy fields are ploughed over so that the late-ripening rice can be planted. The rice shoots of the late-ripening rice are planted at the same time as those of the early-ripening rice at Pure Brightness. The rice shoots of early-ripening rice will die without water in just one day, while those of the late-ripening rice will live through the hot summer and dry weather of the fourth and fifth months. This is a quite remarkable phenomenon. The late-ripening rice must be irrigated constantly in times of continuous fine weathers in autumn when there is little rainfall. The farmers toil in the fields so that the fields will produce enough rice to brew wine with. Since rice plants will die without water after ten consecutive days, farmers developed a kind of non-glutinous rice which can be planted on hilly areas without requiring watering. This is another remarkable phenomenon. There is still another kind of rice called "fragrant rice". It is known for its fragrance and enjoyed by the aristocrats. But this kind of rice has a small yield and lacks nutritious value, so the planting of it is not recommended.

Care of Paddy Fields

If the paddy fields are barren, the rice spears and grains will not grow well. The industrious farmers fertilize their fields to stimulate the growth of rice in various ways. Human and animal excretions, dry cakes of the pressed seeds (they are called dry cakes because out of which the oil has been taken off; of all the dry cakes sesamum and turnip seed cakes are the best, next are those made from rape seeds, followed by those from phoenix tree seeds, and lastly those from camphor, sapium sebiferum and cotton seeds.), and grass and tree



【原文】

(南方磨绿豆粉者，取泐浆灌田肥甚。豆贱之时，撒黄豆于田，一粒烂土方三寸，得谷之息倍焉。)土性带冷浆者，宜骨灰蘸稻根(凡禽兽骨)，石灰淹苗足，向阳暖土不宜也。土脉坚紧者，宜耕垄，叠块压薪而烧之，埴坎松土不宜也。

稻 工

凡稻田刈获不再种者，土宜本秋耕垦，使宿稿化烂，敌粪力一倍。或秋旱无水及怠农春耕，则收获损薄也。凡粪田若撒枯浇泽，恐淋雨至，过水来，肥质随漂而去。谨视天时，在老农心计也。凡一耕之后，勤者再耕、三耕，然后施耙，则土耕地质匀碎，而其中膏脉释化也。

【今译】

能帮助水稻生长，普天之下用的肥料都是相同的。(南方磨绿豆粉时，用泐浆灌田，肥力很大。豆贱之时，将黄豆撒在田里，一粒豆在腐烂后可肥土三寸见方，所得谷的收益一倍于所耗黄豆。)含冷水的土地，宜用骨灰蘸稻根(任何禽兽的骨灰都可以)，或以石灰将秧根埋上，向阳的暖土便无须如此。土质坚硬时，要耕成垄，把硬土块堆压在柴草上烧碎，但黏土、松土便无须此举。

稻田田间管理

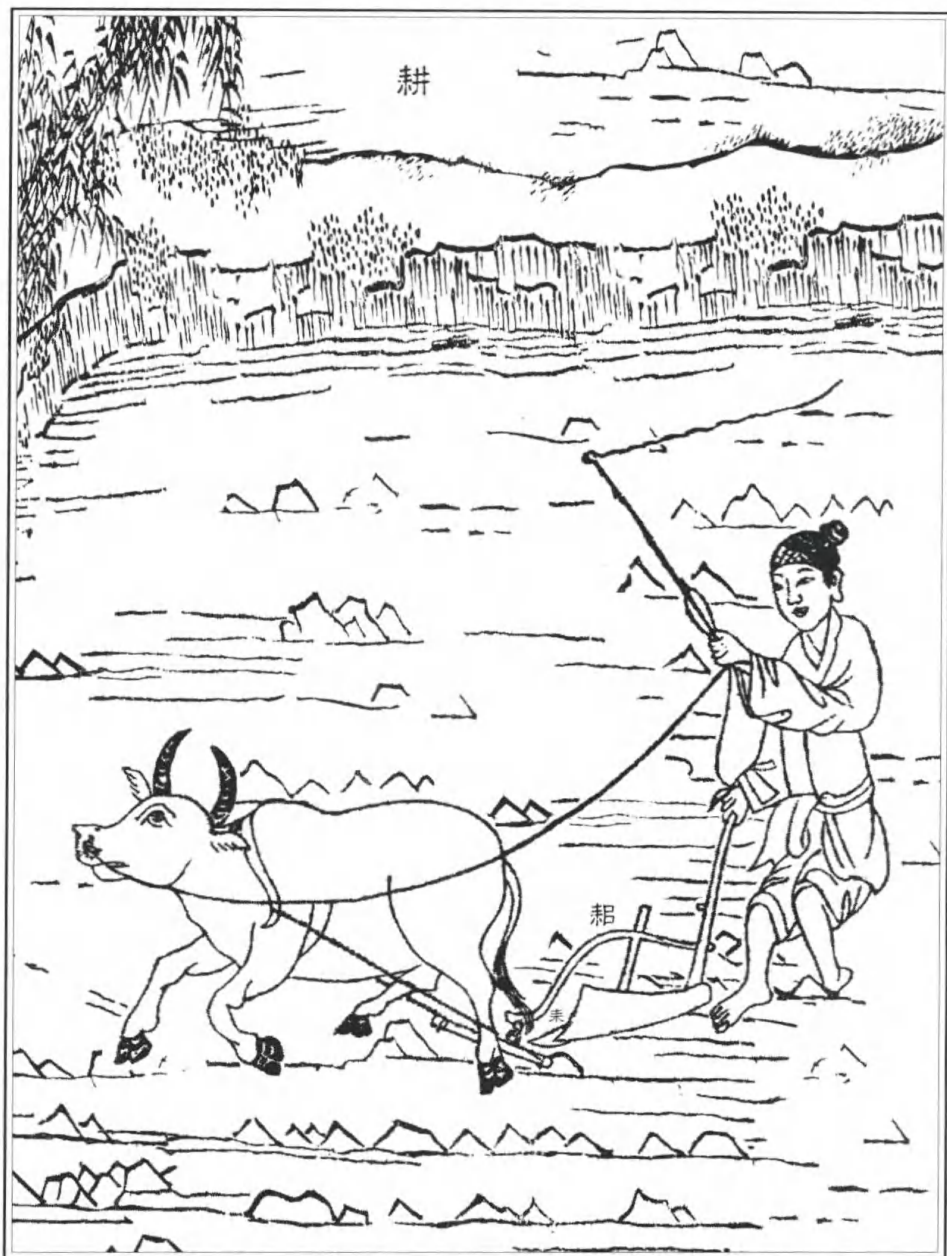
稻田收割后如果不再种植，就应当在当年秋天耕垦土地，使旧稻茬烂在土里，可相当粪肥一倍之肥力。如果秋天干旱无水，或农民拖到明春才耕地，收获就会减少。如果撒枯饼或浇粪水在田里施肥，就怕连雨天的到来，雨水会把肥质冲走。要密切注视天时，这就要靠老农的心计了。耕过一次之后，勤者还可再耕、三耕。然后再耙地碎土使土质匀碎，肥分自会在土中散开。



leaves can all be used as fertilizers. These fertilizers are commonly used throughout the country. If the soil contains cold water, bone ashes of any bird or animal or lime should be sprinkled around the roots of the young plants. But if the soil faces the sun and is warm, the above procedure is not followed. (In the south, when green bean flour is made, its liquid waste is used as a very rich fertilizer to irrigate the fields and when the soy-beans become very cheap, they can be scattered in the fields. One rotten bean can enrich an area of field measuring three *cun* square; and the cost is later twice repaid by the grain yield.) If the soil contains cold water, bone ashes should be spread around the roots of the rice seedlings (the bones of any bird and animal will do). If the soil is hard, the fields should be ploughed into ridges. The clods should be stacked on top of firewood or straw and burned to loosen. But this procedure is not followed if the soil is clayey or sandy.

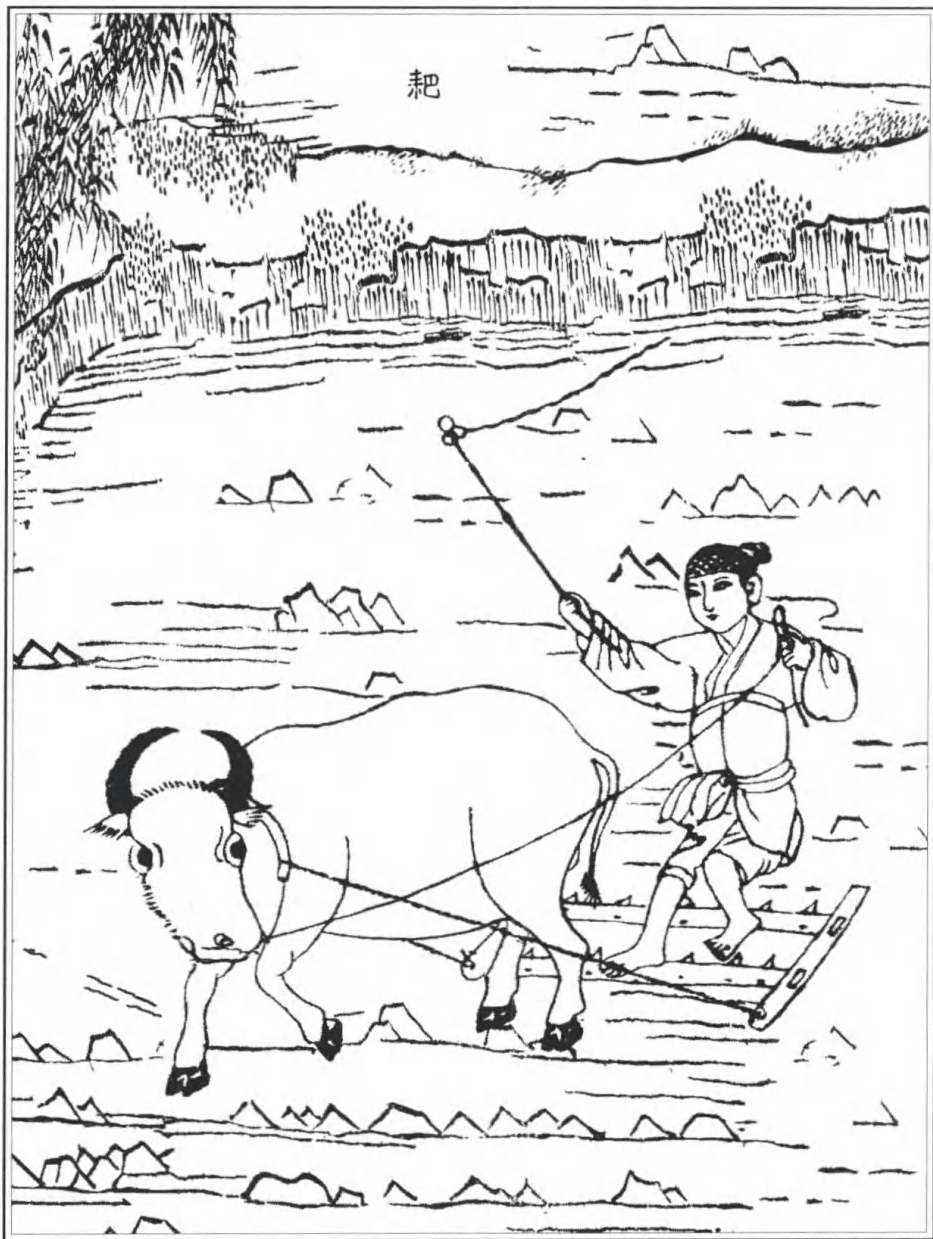
The Cultivation of Paddy Fields

If the paddy fields are not to be planted again after the harvest, the fields must be ploughed over so that the stalks will rot in the ground. The decomposed stalks make a fertilizer twice as effective as manure. If the fields are not ploughed over until the next spring due to a drought in autumn or due to the farmers' laziness, the following harvest will be reduced. If dry cakes of the pressed seeds or liquid manure are applied to fertilize the fields and there happen to be consecutive rainy days, the fertilizers will be washed away. Therefore, the experienced farmers always observe the weather conditions in deciding when to fertilize their fields. Industrious farmers plough over the fields two or three times before they use the harrow to break the soil evenly and finely. In this way the fertilizers will be well distributed in the soil.



耕

Loosening the soil by ploughing



耜

Breaking the soil into fine particles by harrowing



【原文】

凡牛力穷者，两人以杠悬耜，项背相望而起土，两人竞日，仅敌一牛之力。若耕后牛穷，制成磨耙，两人肩手磨轧，则一日敌三牛之力也。凡牛，中国唯水、黄两种，水牛力倍于黄。但畜水牛者，冬与土室御寒，夏与池塘浴水，畜养心计亦倍于黄牛也。凡牛春前力耕汗出，切忌雨点，将雨，则疾驱入室。候过谷雨，则任从风雨不惧也。

吴郡力田者以锄代耜，不借牛力。愚见贫农之家，会计牛值与水草之资、窃盗死病之变，不若人力亦便。假如有牛者供办十亩，无牛用锄而勤者半之，既已无牛，则秋获之后田中无复刍牧之患，而菽、麦、麻、蔬诸种纷纷可种。以再获偿半荒之亩，似亦相当也。

【今译】

没有耕牛的农户，则两人以木杠悬着犁铧，一前一后地推拉而翻土，两人一天的劳动只抵一牛之力。要是耕地以后无牛可驱，便做一磨耙，两人用肩和手拉着耙碎土，则一天的劳动可抵三牛之力。中原的牛只有水牛与黄牛两种，水牛比黄牛力大一倍。但畜养水牛，冬天要有土屋御寒，夏天还要放到池塘中浴水，则畜养水牛也比黄牛费事一倍。牛在春分前用力耕地时会出汗，切忌雨淋，将要下雨时赶快赶到室内。待过了谷雨，则任凭风吹雨淋都不怕了。

苏州一带的耕田人用锄代替犁，而不借牛力。依笔者愚见，贫苦农家要是核算一下买牛和水草的费用、牛被盗和病死的变故，还不如用人力便当。假如有牛的人家耕种十亩地，没有牛而用锄勤快劳动的人家耕种五亩，既然无牛，则秋收之后就无需考虑田里种饲草、放牧，而豆、麦、麻、菜等尽可种植。用第二次的所获来补偿少耕种五亩地的损失，似乎也得失相当，还是上算的。



In farming households where there are no oxen to use, farmers fix a pole to the plough and two men pull the plough by placing the pole on their shoulders, walking one behind the other. One day's work by two men is equal to that by one ox. If the farmers have no oxen to drive a harrow, they construct a rotary harrow that is pulled by two men. They use their shoulders and hands to operate the harrow to break the clods. One day's work by two men is equal to that of three oxen. There are only two kinds of cattle in the Central Plains of China, the water buffalo and the yellow ox, and the former is twice as strong as the latter. However, it requires twice as much care to raise water buffalos compared with raising the yellow oxen because the water buffalos must be housed in earthen sheds during the cold winter and provided with a pond for bathing in summer. Prior to the Spring Equinox cattle perspire a lot while ploughing, so they must be driven to the sheds immediately before it rains to keep them from exposure to the rain. But they are immune to wind and rain after the Grain Rain.

The farmers in the areas centred around Suzhou use hoes instead of ploughs, and do not use working cattle. Considering the cost of cattle and the feed, and the risks of sickness, theft and death, poor farmers would rather use human labour in ploughing. If a farming household with cattle can work ten *mu* of land, then an industrious farmer, by using a hoe, can work five *mu* of land. Since these farming families do not have working cattle, they do not need to worry about such matters as growing forage grass and grazing, and can plant beans, wheat, sesame and vegetables after the harvest. The harvest of the above grains and vegetables will compensate the farmers for the loss resulting from the five *mu* of land that is not planted by using working cattle. It seems to be a good arrangement.



【原文】

凡稻分秧之后数日，旧叶萎黄而更生新叶。青叶既长，则耔（俗名挹禾）可施焉。植杖于手，以足扶泥壅根，并屈宿田水草，使不生也。凡宿田茵草之类，遇耔而屈折。而稗、稗与茶、蓼，非足力所可除者，则耘以继之。耘者苦在腰、手，辨在两眸，非类既去，而嘉谷茂焉。从此泄以防潦，溉以防旱，旬月而奄观铨刈矣。

稻 灾

凡早稻种，秋初收藏，当午晒时，烈日火气在内，入仓廩中关闭太急，则其谷沾带暑气（勤农之家偏受此患）。明年，田有粪肥，土脉发烧，东南风助暖，则尽发炎火，大坏苗穗，此一灾也。若种谷晚凉入廩，或冬至数九天收贮雪水、冰水一瓮。清明湿种时，每石以

【今译】

水稻插秧几天后，旧叶便枯黄而又长出新叶。新叶长出后，就可以耔田壅根（俗名叫“挹禾”）。方法是手把着木棍，用脚把泥培在稻秧根上，并用脚把稻田里的水草踩弯，埋在泥里，使其不能生长。稻田里的水稗子之类可用脚踩折。但稗、稗与茶、蓼等杂草不是用脚力可除去的，必须接着以手来除草。除草的人腰、手辛苦，而分辨秧、草要靠双眼。杂草除尽，禾苗才长得茂盛。此后便是排水防涝、灌水防旱，个把月后就要准备开镰收割了。

稻 灾

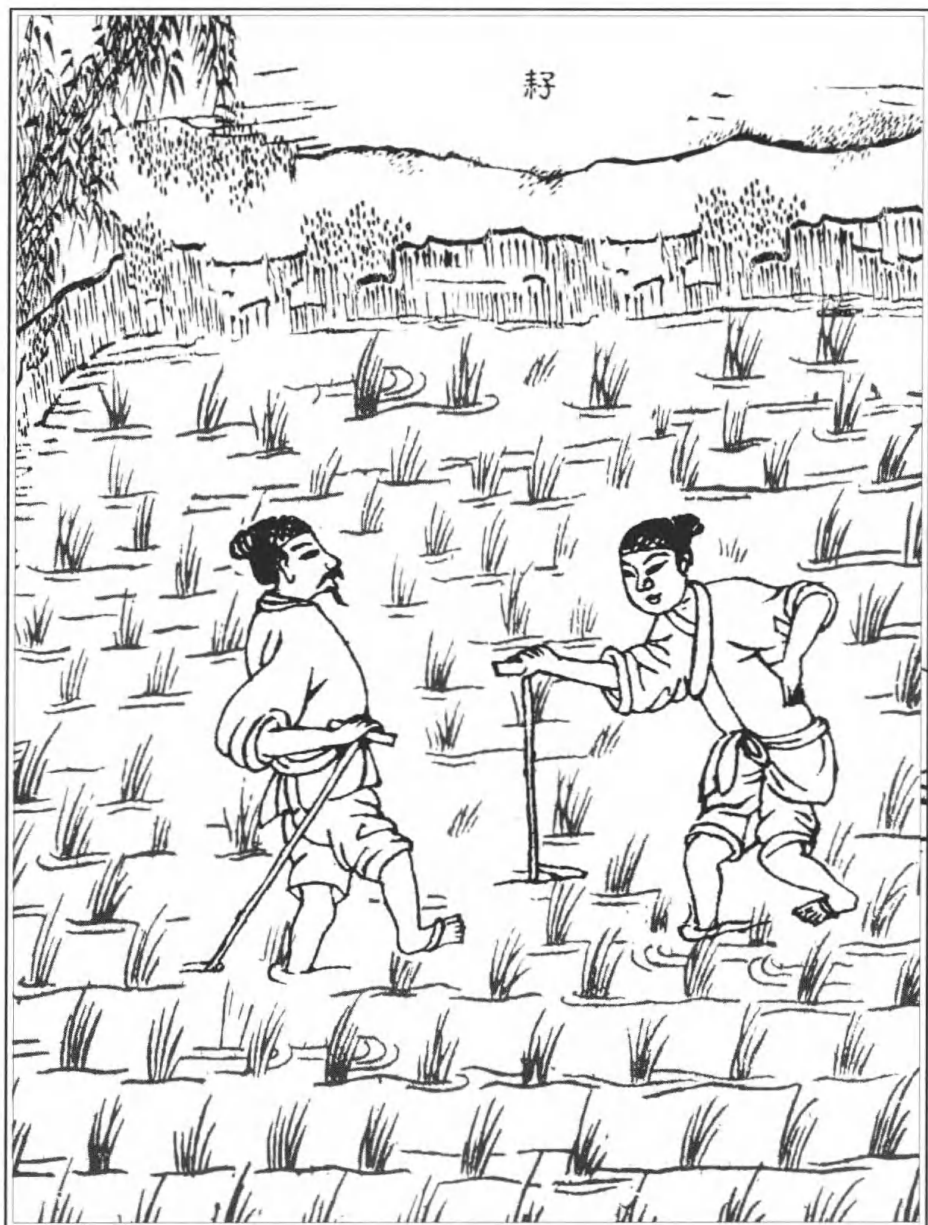
早稻稻种在秋初收藏时，如果正午在烈日高温下晒，稻谷内含有火气，收入仓库后又急忙关闭，则谷种沾带着热气（勤劳的农家偏受此害）。明年播种后，田里有粪肥使土温上升，又有东南风带来的暖热，则尽使稻子发烧，苗穗受到大的损坏，这是第一个灾害。如果稻种在晚上凉快时入仓，或在冬至后的数九寒天收贮一缸雪水、冰



The old leaves wither on the rice plants and new leaves grow out a few days after transplanting. When new leaves start to grow, it is time to heap mud around the roots of the young plant (nurturing the root, which is commonly known as “foot-patting the plants”). Farmers lean on a stick for balance and heap mud around the roots with one’s feet. Meanwhile, farmers bend the weeds with their feet so that they are buried in the mud and cannot grow again. Weeds such as *Beckmannia erucaeformis* can be broken by foot, but darnels, tares and sweetweed cannot be broken this way and they have to be uprooted by hand. Weeding in the paddy fields is hard on one’s back and hands, and distinguishing rice plants from weeds requires keen eyesight. The rice plants will flourish after all undesirable weeds are eliminated. After all these steps of farming, farmers need to drain excessive water to prevent flooding or to irrigate the fields to prevent a drought. In about a month’s time, the farmers are ready to harvest with scythes.

Rice Disasters

If early season seed rice is exposed to the scorching sun when being collected and stored in early autumn, it will have internal heat concealed in the rice. If the door of the barn is closed right after the seed rice is put into it, heat will be dormant in it (diligent farming families suffer from such a disaster). After being sown in the next spring, with the manure in the fields raising the temperature of the soil, and furthermore with the warm wind blowing from the southeast, the rice will suffer heat and the rice seedlings will be damaged. This is the first disaster. If the seed rice is put into the barn when the weather is cool in the evening, or if a jar of snow water or ice water in the coldest day of the year after the Winter Solstice is stored and several bowls of such water is sprayed into a *dan* of the seed rice which is being soaked for



耔

Foot-patting the plant



耘

Hand weeding



【原文】

数碗激洒，立解暑气，则任从东南风暖，而此苗清秀异常矣。（崇在种内，反怨鬼神。）

凡稻撒种时，或水浮数寸，其谷未即沉下，骤发狂风，堆积一隅，此二灾也。谨视风定而后撒，则沉匀成秧矣。凡谷种生秧之后，防雀鸟聚食，此三灾也。立标飘扬鹰俑，则雀可驱矣。凡秧沉脚未定，阴雨连绵，则损折过半，此四灾也。邀天晴霁三日，则粒粒皆生矣。凡苗既函之后，亩土肥泽连发，南风熏热，函内生虫（形似蚕茧），此五灾也。邀天遇西风雨一阵，则虫化而谷生矣。

凡苗吐穉之后，暮夜鬼火游烧，此六灾也。此火乃腐木腹中放出。凡木母火子，子藏母腹，母身未坏，子性千秋不灭。每逢多雨之年，孤野墓坟多被狐狸穿塌。其中棺板为水浸，朽烂之极，所谓

【今译】

水。清明浸种时每石稻种激洒几碗，则立刻消除热气，播种后任从东南暖风再吹，禾苗也长得清秀异常。（这种灾害的症结在稻种内部，有人却埋怨是鬼神作怪。）

撒播稻种时，如果田内水深数寸，种子还未及沉下，突然刮起狂风，把稻种吹走并堆积在一角，这是第二个灾害。要看准待风停以后撒种，则均匀下沉而长出秧来。稻谷生秧后就怕雀鸟聚食，这是第三个灾害。在田里立标杆悬挂假鹰随风飘动，可驱赶鸟雀。稻秧扎根未定，遇上阴雨连绵，则损伤过半，这是第四个灾害。要是遇到天晴三日，就粒粒都成活了。秧苗长出新叶后，土里肥料不断散发，南风吹暖，稻叶上就会生虫（虫形状像蚕茧），这是第五个灾害。这时盼望来一场西风阵雨，则虫死而稻谷就有长势了。

稻苗吐穗后，夜晚被“鬼火”游烧，这是第六个灾害。这种火是从朽烂的木头中放出的。木生火，火藏于木中，木未坏而火便在其中永不消失。每逢多雨之年，野外坟墓多被狐狸穿塌。其中棺板被



quick sprouting, the heat inside the seed rice will immediately disappear and the seedlings will grow well in spite of the warm wind blowing from the southwest. (The crux of this disaster is inside the seed rice, yet some people think it is the ghosts and gods that are destroying the rice.)

If the water in the rice paddy fields is several *cun* deep when the seeds are scattered, the seed rice will be blown into a corner by a sudden wild wind before it sinks down into the soil. This is the second disaster. If the seeds are scattered after the wind stops, then they will sink evenly and the rice seedlings will grow well. When the rice seedlings grow out of water, it is possible that they may be eaten by birds. This is the third disaster. Erecting posts in the fields and hanging an eagle scarecrow which flies with the wind can scare away the birds. If there is an unbroken spell of rainy days while the seedlings are taking root, over half of the seedlings will be damaged. This is the fourth disaster. If there are three fine days while the seedlings are taking root, all the seedlings will grow well without being damaged. When the seedlings grow new blades, the fertilizers in the soil begin to emit energy, and the warm wind from the south blows, rice plant skippers will appear on the blades. (The insects look like silkworms). This is the fifth disaster. If a shower occurs together with a cool wind from the west, the insects will die and the rice will gain a momentum of growth.

When the rice seedlings are earring up, they will be burned at night by will-o'-the-wisp. This is the sixth disaster. This kind of fire comes from the rotten wood. Fire is dormant in wood and fire exists inside and does not come out when wood is not rotten. When there is much rain in some year, the graves in the fields collapse due to the holes which foxes make in the graves. The planks of the coffin are soaked in water and become rotten. The fire in the wood has no place



【原文】

母质坏也。火子无附，脱母飞扬。然阴火不见阳光，直待日没黄昏，此火冲隙而出，其力不能上腾，飘游不定，数尺而止。凡禾穡、叶遇之立刻焦炎。逐火之人见他处树根放光，以为鬼也。奋挺击之，反有鬼变枯柴之说。不知向来鬼火见灯光而已化矣。（凡火未经人间传灯者，总属阴火，故见灯即灭。）

凡苗自函活以至颖粟，早者食水三斗，晚者食水五斗，失水即枯（将刈之时少水一升，谷粒虽存，米粒缩小，入碾、臼中亦多断碎），此七灾也。汲灌之智，人巧已无余矣。凡稻成熟之时，遇狂风吹粒殒落，或阴雨竟旬，谷粒沾湿自烂，此八灾也。然风灾不越三十里，阴雨不越三百里，偏方厄难亦不广被。风落不可为。若贫困之家苦于无

【今译】

水浸而朽烂至极，也就是木质朽坏了。木中之火没有依附，便脱木飞扬。但阴火总是避开阳光，直到日落黄昏，此火才从缝隙中冲出，又无力上升，于是在数尺范围内飘游不定。稻的穗、叶要是遇到此火便立刻烧焦。追逐这种火的人见别处树根放光，以为是鬼。挥棍猛力击之，反而有“鬼变枯柴”之说。但不知历来鬼火见灯光即灭。（不是由人点灯、燃薪发出的火，都属于阴火，见灯即灭。）

稻苗从生叶到抽穗结实，早稻每札需三斗水，晚稻需水五斗，失水即枯（将收割时如少水一升，谷粒数目虽存，但米粒缩小，入碾、臼中加工便粉碎），这是第七个灾害。这时便要灌溉，而这方面人的技巧已得到充分的发挥。稻在成熟之时，遇狂风会将稻粒吹落，或阴雨连旬而使谷粒沾湿自烂，这是第八个灾害。然而狂风不会刮过三十里，阴雨不会超过三百里方圆。局部地方成灾，不会扩及广泛地区。风吹落稻谷是无法防范的。如果贫困之家苦于阴雨，可将湿稻谷放入锅内，锅下



to attach to and thus goes out of the wood and floats in the air. But the fire of the nether world always avoids sunlight and rushes out from cracks only at dusk when the sun sets. The fire does not rise high but just floats here and there within an area of a few meters. The fire burns the ears and blades of rice. Those who follow the fire find that there is flaming near the tree roots and think it is a ghost. They put out the fire by beating it with a stick, and there appears the saying that "the ghost has turned into a tree". However, they do not know that will-o'-the-wisp extinguishes when it meets lamplight. (Fire which is not by lighting a lamp or burning firewood belongs to fire of the nether world, and this fire extinguishes when it meets lamplight.)

From growing blades to earing up and bearing grain, the seedlings require irrigation, without which the rice withers. The early season rice needs three *dou* of water and late season rice five *dou* (toward harvesting, a shortage of one *sheng* of water will cause the shrinkage of the grains of rice and though the number of the rice grains remains the same, and when being ground, the grains will be smashed). This is the seventh disaster. This means that irrigation is imperative and the farmers are well skilled therein. When the rice is ripening, the grains of rice will be blown off the stalks if there is a wild wind passing over, or the grains become wet and rotten if there is an unbroken spell of wet weather for ten consecutive days. This is the eighth disaster. But the wild wind affects no more than a circumference of thirty *li* and wet weather no more than a circumference of three hundred *li*. The disasters are limited to a local area and are not extended to a broader area. It can not be prevented if the wind blows off the grains of rice. A poor family which suffers losses of grains due to wet weather can collect the fallen rice, put it into the wok to fry to get rid of the husk of rice so that it can be eaten. This is



【原文】

霁，将湿谷盛于锅内，燃薪其下，炸去糠膜，收炒粳以充饥，亦补助造化之一端矣。

水 利

凡稻防旱借水，独甚五谷。厥土沙泥、硖膩，随方不一。有三日即干者，有半月后干者。天泽不降，则人力挽水以济。凡河滨有制筒车者，堰陂障流，绕于车下，激轮使转，挽水入筒，一一倾于枳内，流入亩中。昼夜不息，百亩无忧。（不用水时，栓木碍止，使轮不转动。）其湖、池不流水，或以牛力转盘，或聚数人踏转。车身长者二丈，短者半之。其内用龙骨拴串板，关水逆流而上。大抵一人竟日之力灌田五亩，而牛则倍之。

其浅池、小浚不载长车者，则数尺之车一人两手疾转，竟日之

【今译】

点火，炒去糠壳，以炒熟的米来充饥，这也是补救自然灾害的一个办法。

水 利

水稻比其余谷物更需要防旱。稻田里的土有沙土、泥土、瘦土、肥土，随地而异。有不灌水三天就干的，也有半月后才干的。天不下雨，就要人力引水接济。靠河边的农家有造筒车的，筑坝拦水，让水经车下冲激水轮旋转，再将水引入筒内，各个筒内的水分别倾入槽中，再流进田里。昼夜不息，不愁灌百亩稻田。（不用水时，用木栓卡住，使水轮不转动。）湖泊、池塘边水不流动的地方也可以用牛力牵动转盘，转盘再带动水车引水。也可以由数人踏转水车引水。水车车身长的二丈，短的一丈，水车内用龙骨拴一串串木板，带水逆行向上，再流入田里。大概一人一天之力可灌田五亩，用牛可灌十亩。

浅池、小水沟无法放置长的水车，则用数尺长的拔车，一人两手握摇柄迅速转动，终日劳动只可灌二亩而已。扬州用数扇风帆，

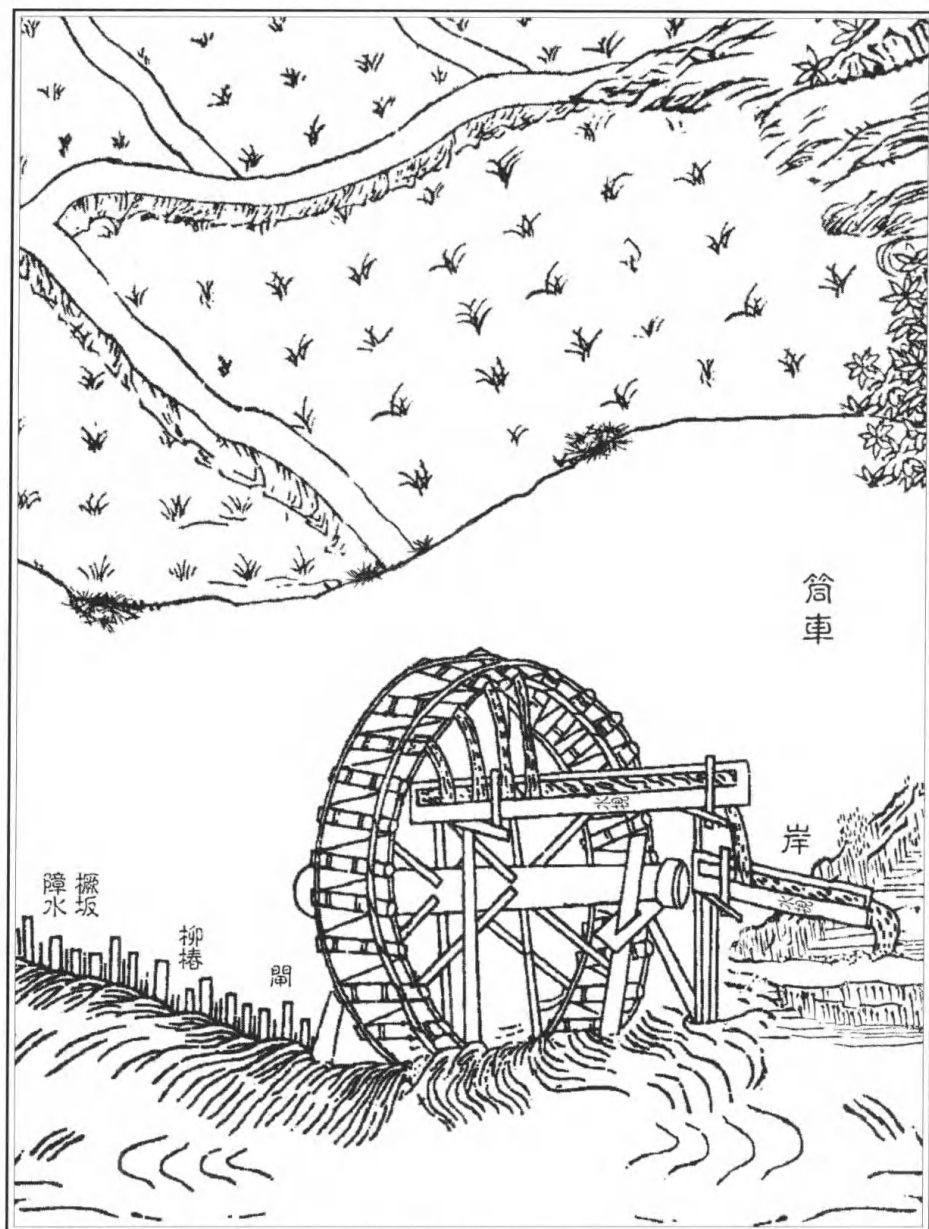


a good remedial measure for natural disasters.

Water Conservancy

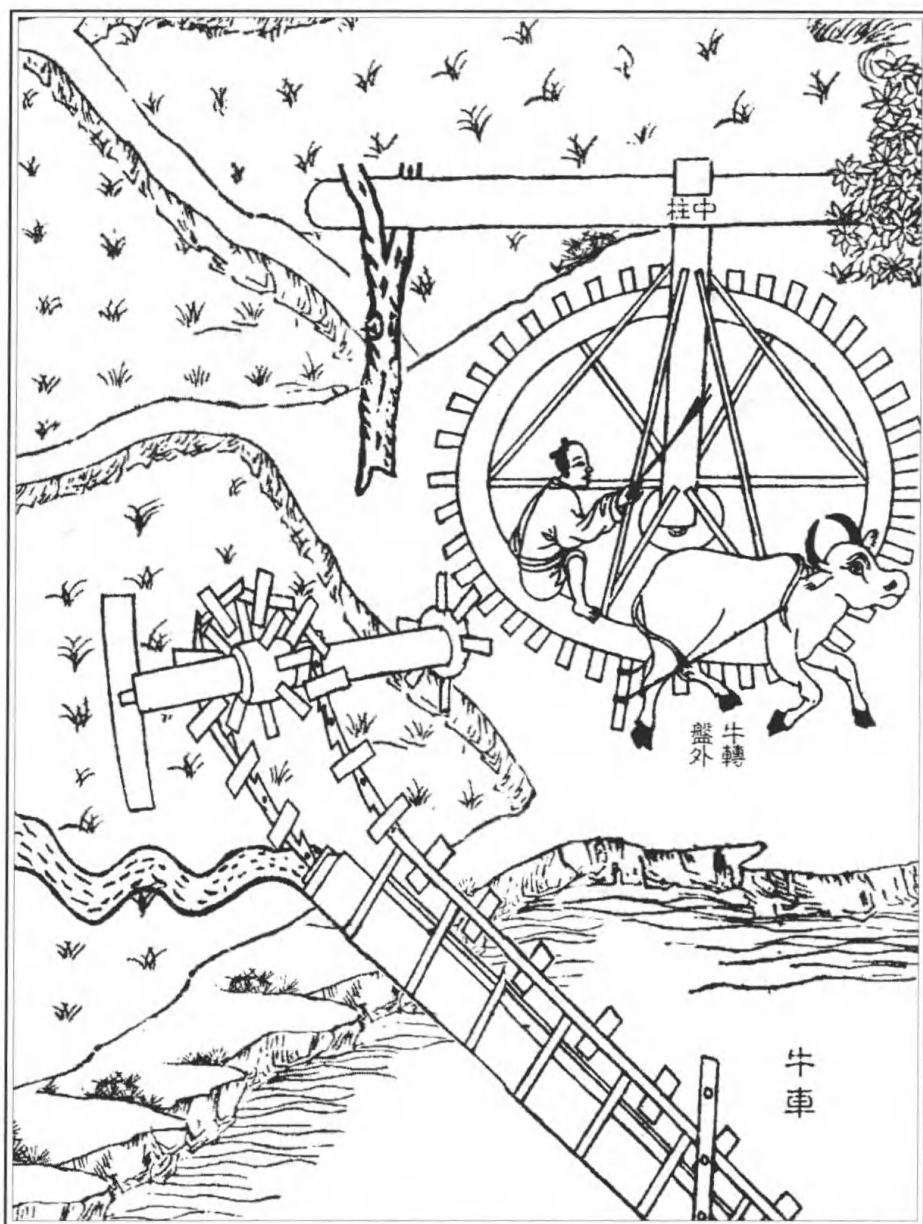
Rice is more vulnerable to drought than other food crops. The soil of the rice paddy fields is of many types, either sandy, muddy, barren or fertile, being different from place to place. Without irrigation for just three days, certain types of soils become dry, while others may not become dry for half a month. If it does not rain, farmers should draw water for irrigation. Farming families living near rivers build dams and construct waterwheels with tubes on the wheels so that the river water turns the waterwheels. Each of the small tubes on the wheel draws water from the river and, in turn, all the water from the tubes which pours into the groove goes to the field. With the waterwheels working day and night, irrigation of one hundred *mu* of rice paddy fields is accomplished (When no irrigation is required, a bolt is used to stop the waterwheel from working). Near lakes and ponds where there is still water, an ox is used to turn the waterwheel, or several persons manually operate the waterwheel to draw water. The larger waterwheel is two *zhang* long, and the shorter one is one *zhang* in length. The waterwheel is a dragon-bone water-lift (made of wooden boards tied one by one to the dragon-bone) which brings water against the current and let it go to the field. A waterwheel operated by one man can irrigate one *mu* of rice paddy field, while one powered by an ox, ten *mu*.

Waterwheels can not be applied to the shallow ponds and water canals, so hand cranked wheels of several *chi* in length are used instead. A man turns the handle with both hands to quickly turn the wheel only to irrigate two *mu* of rice paddy field. In Yangzhou a number of sails are employed to turn the waterwheel with wind power, but



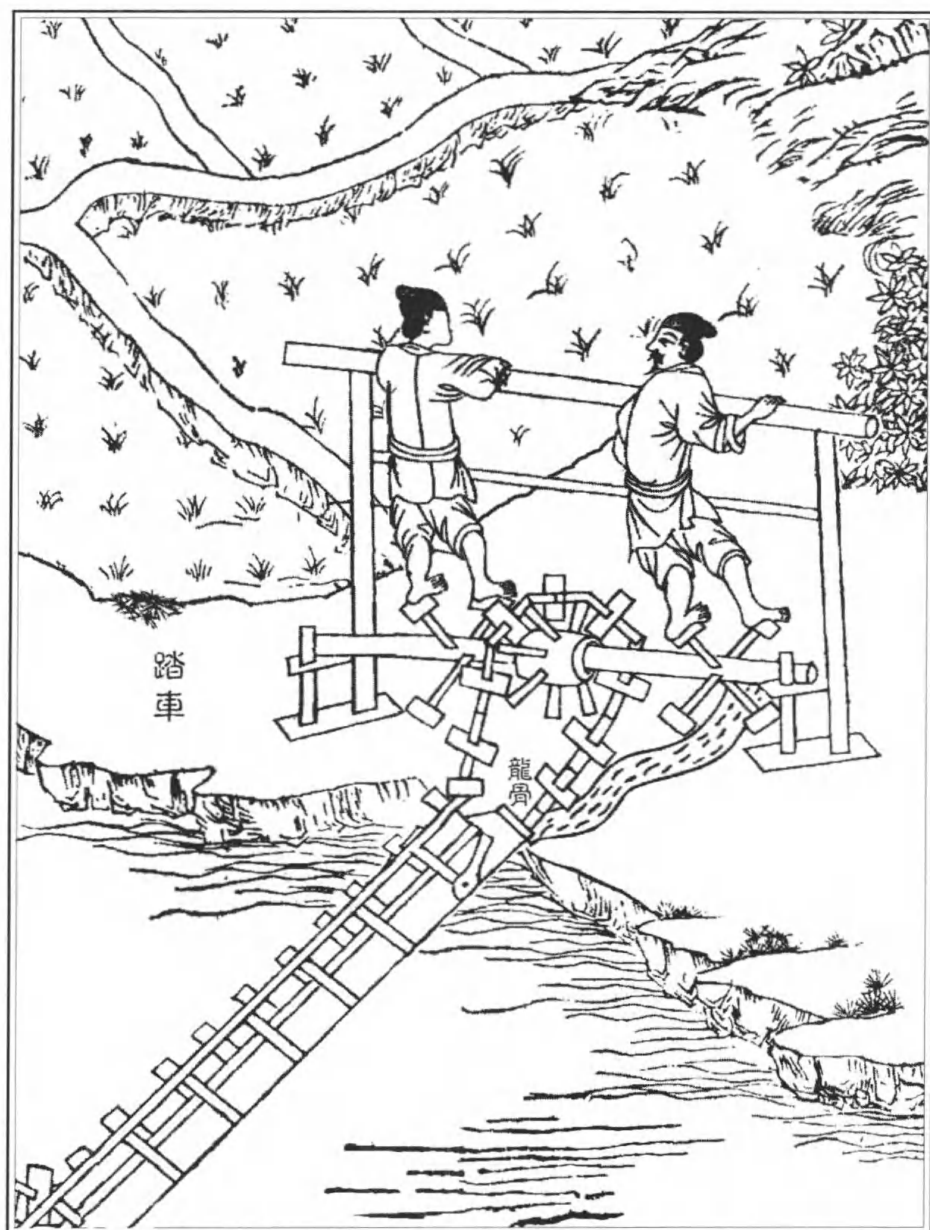
筒车

The tube waterwheel



牛車

The ox-powered waterwheel



踏車

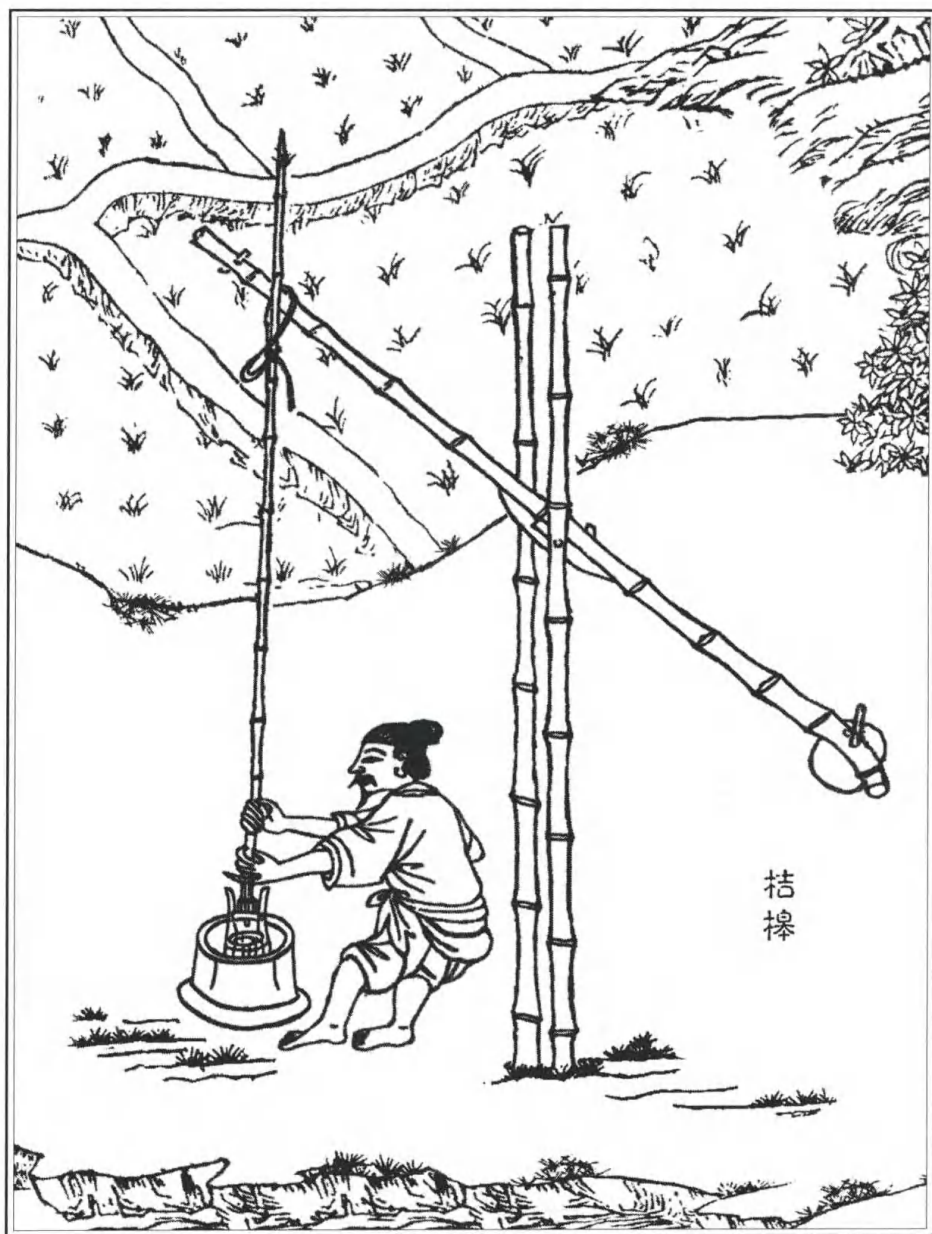
The man-powered waterwheel



拔車

拔車

The hand cranked wheel



桔槔

The counterweight lever



轱辘

The pulley wheel



【原文】

功，可灌二亩而已。扬郡以风帆数扇，俟风转车，风息则止。此车为救潦，欲去泽水以便栽种。盖去水非取水也，不适济旱。用桔槔、辘轳，功劳又甚细已。

麦

凡麦有数种。小麦曰来，麦之长也。大麦曰牟、曰秬。杂麦曰雀、曰莽。皆以播种同时，花形相似，粉食同功，而得麦名也。四海之内，燕、秦、晋、豫、齐鲁诸道，烝民粒食，小麦居半，而黍、稷、稻、粱仅居半。西极川、云，东至闽、浙、吴、楚腹焉，方圆六千里中，种小麦者二十分而一，磨面以为捻头、环饵、馒首、汤料之需，而饕餮不及焉。种余麦者五十分而一，闾阎作苦以充朝膳，而贵介不与焉。

麦独产陕西，一名青稞，即大麦，随土而变。而皮成青黑色者，秦人专以饲马。饥饿，人乃食之。雀麦细穗，穗中又分十数细子，间亦野生。莽麦实非麦类，然以其为粉疗饥，传名为麦，则麦之而已。

【今译】

靠风力转动水车，有风则车转，风息则车停。这种拔车是排涝用的，旨在排水以便栽种。因为拔车排水，而不是取水，不适用于抗旱。用桔槔、辘轳取水，工效就小了。

麦

麦有数种，小麦叫来，是麦中最主要的品种。大麦叫牟或秬，杂麦有叫雀麦的，有叫莽麦的。这些麦都是同一时间播种，花形相似，又都磨成面粉吃用，所以都称为麦。中国河北、陕西、山西、河南、山东各省居民口粮中，小麦占一半，而黍、稷、稻、粱总共只占一半。西至四川、云南，东至福建、浙江、江苏及中部的楚地，方圆六千里中，种小麦的占二十分之一。把小麦磨成面粉做花卷、糕饼、馒头、面条，而不作正餐。种其余麦类的，占五十分之一，贫苦人家用作早饭，而富贵人家是不吃的。

麦只产于陕西，又叫青稞，即大麦，随土质不同而有变种。外皮青黑色的，陕西人专用于喂马，饥荒时人才吃。雀麦穗细，每穗又分十几个小穗，间亦有野生的。莽麦其实并不是麦类，然因其磨成面粉充饥，统称为麦，也姑且就算麦类吧。



the waterwheel stops without wind. This kind of waterdrawing wheel is used to drain flooded fields. If water is drawn by using a counterweight lever and a pulley wheel, the efficiency is rather low.

Wheat

Wheat, in the broad sense, is of different types, but in the narrow sense, it is called *lai*, which is the main type of wheat. Barley is called *mou* or *kuang*. Then there are miscellaneous types of wheat consisting of oat and buckwheat. These types of wheat are sown at the same time. They have similar blossoms and all of them are ground into powder as food, so all of them are called wheat. In such places as Hebei, Shaanxi, Shanxi, Henan, Shandong provinces, wheat contributes half of the grains of the residents, while millet, proso millet and rice combined the other half, within a circumference of 6,000 *li* reaching as far as Sichuan Province in the west and Fujian, Zhejiang, Jiangsu and the Land of Chu in the east. One out of twenty people plant wheat. Wheat is ground into powder to make fancy-shaped steamed rolls, thin pancakes, steamed bread and noodles. One out of fifty people plants other types of wheat. Poor families eat them for breakfast, while the rich do not.

The *kuang* wheat, sometimes called highland barley, is planted only in Shaanxi Province. There are different kinds due to the different soil textures. In Shaanxi Province, the black barley is used to feed horses, yet in times of famine, humans also eat it. Oat has fine ears and each ear has over ten fine ears. Oat also has wild ones. Buckwheat is actually not wheat, yet it is ground into powder as food. It has been regarded as wheat for so long that we may as well call it wheat.

Wheat in North China has a longer growing period which covers the four seasons of the year. It is sown in autumn and harvested in early



【原文】

凡北方小麦，历四时之气，自秋播种，明年初夏方收。南方者种与收期时日差短。江南麦花夜发，江北麦花昼发，亦一异也。大麦种、获期与小麦相同。荞麦则秋半下种，不两月而即收。其苗遇霜即杀，邀天降霜迟迟，则有收矣。

麦 工

凡麦与稻，初耕、垦土则同，播种以后则耘、耔诸勤苦皆属稻，麦唯施耨而已。凡北方厥土坟垆易解释者，种麦之法耕具差异，耕即兼种。其服牛起土者，耒不用耜，并列两铁于横木之上，其具方语曰耩。耩中间盛一小斗贮麦种于内，其斗底空梅花眼。牛行摇动，种子即从眼中撒下。欲密而多，则鞭牛疾走，子撒必多。欲稀而少，则缓其牛，撒种即少。既播种后，用驴驾两小石团压土埋麦。凡麦

【今译】

北方的小麦生长期，经历一年四季的气候，秋天播种，来年初夏才收割。南方小麦从播种到收割，时间略短些。江南麦夜里开花，江北麦白天开花，这也是一件奇异的事。大麦播种和收割日期与小麦相同。荞麦在中秋时播种，不到两个月就收获。荞麦苗遇霜就死，所以希望霜降得晚些，就有收成了。

麦田田间管理

麦田的耕地、翻土与稻相同，播种以后稻田要勤于壅根、拔草，麦田只要锄草就行。北方土质疏松易于打碎，种麦的方法、耕具与稻有差异，是耕与种同时并举。北方驱牛翻土不用犁，而是用横木插上两个并排的铁尖，当地称为耩。耩中间放一小斗，内装麦的种子，木斗底钻些梅花眼。牛走摇动小斗，种子就从眼中撒下。想要种得密而且多，就赶牛快走，种子撒得便多。欲稀而少，则慢赶牛，撒种即少。播种后，用驴拉两个小石碾压土埋麦。麦种必须压紧方



summer of the next year. Wheat in the south has a shorter growing period. South of the Yangtze River, wheat blossoms at night, while wheat in the north of the Yangtze River blossoms during the day. This is rather strange. The sowing and harvesting of barley is the same as that of wheat. Buckwheat is sown in mid autumn and harvested in less than two months' time. The seedlings of buckwheat die if they are stricken by frost. Farmers hope that frost will arrive late, so that they can have a bumper harvest.

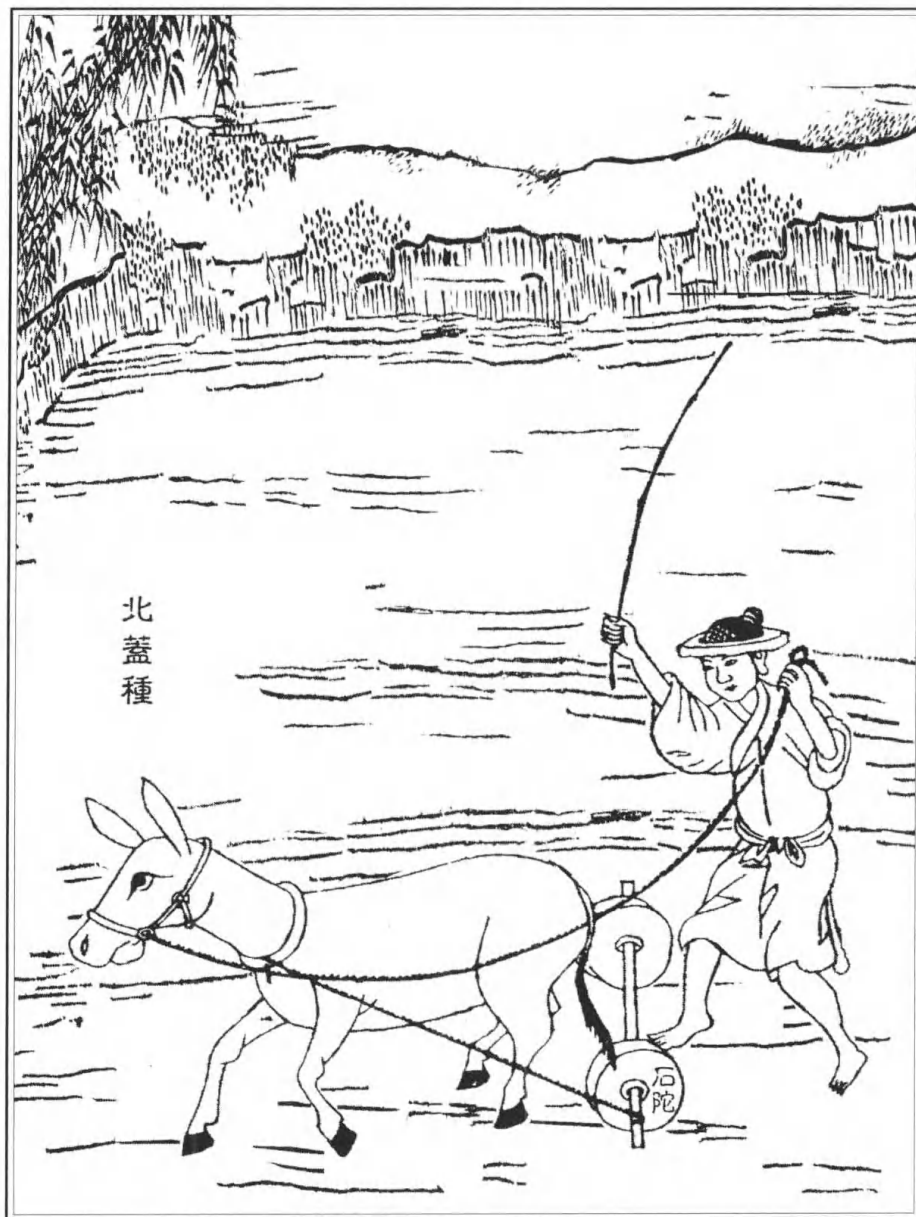
Management of Wheat Fields

Tilling and turning up the soil of wheat fields are the same as that of rice paddy fields. Unlike rice paddy fields, which require heaping soil or fertilizer over or around the roots, the wheat fields require only weeding after sowing. The soil in the north is porous and easily smashed. The way of planting wheat and the tillage implements are different from those of planting rice in that the ploughing and sowing are done simultaneously. In the north, oxen are used to turn up the soil instead of using a plough. In this case, the plough's point is removed and two iron diggers are fixed in its place on the cross-beam which the local dialect calls *jiang*. A small square box containing wheat seeds is placed in the centre of *jiang*. Plum-blossom-shaped holes are drilled at the bottom of the box through which seeds fall to the ground when the apparatus is shaken as the ox moved forward. If farmers wish to sow wheat dense, they will make the ox go faster, otherwise they will sow wheat sparse. After the wheat is sown, a donkey is used to pull two stone rollers to level the ground so that the seeds are covered underneath. Wheat seeds must be covered firmly in the ground in order to sprout. Being different from the north, the wheat fields in the south



北耕兼种

The plough-seeder



北蓋種

Stone rollers used in North China



南种牟麦

Hand sowing and foot-covering the seeds



耨

Weeding with wide-blade hoes



【原文】

种压紧方生。南地不同北者，多耕、多耙之后，然后以灰拌种，手指拈而种之。种过之后，随以脚跟压土使紧，以代北方驴石也。

播种之后，勤议耨锄。凡耨草用阔面大镢。麦苗生后，耨不厌勤（有三过、四过者）。余草生机尽诛锄下，则竟亩精华尽聚嘉实矣。功勤易耨，南与北同也。凡粪麦田，既种以后，粪无可施，为计在先也。陕洛之间，忧虫蚀者，或以砒霜拌种子，南方所用，唯炊烬也。南方稻田有种肥田麦者，不冀麦实。当春小麦、大麦青青之时，耕杀田中蒸罨土性，秋收稻谷必加倍也。

凡麦收空隙，可再种他物。自初夏至季秋，时日亦半载，择土宜而为之，惟人所取也。南方大麦有既刈之后乃种迟生粳稻者。勤农作苦，明赐无不及也。凡荞麦，南方必刈稻，北方必刈菽、稷而后种。其性稍吸肥腴，能使土瘦。然计其获入，业偿半谷有余，勤农之家何妨再粪也。

【今译】

活。南方与北方不同，南方麦田必须多次耕、耙后，再用草木灰拌种，以手指撮起点播。播种后，随即以脚压土使紧，以代替北方用驴拉石碾压土。

播种以后要勤于锄草，锄草用宽面大锄。麦苗出来后，锄草不厌其勤（有三次、四次者）。杂草锄尽不再生长时，地里的肥分就都用来长麦粒了。工夫勤，草就容易锄尽，在这方面南方与北方是一样的。麦地不必在播种以后施肥，要计划好在播种前粪田。陕西洛水地区怕虫侵蚀麦种，有用砒霜拌种的，南方只用草木灰。南方稻田有种肥田麦的，并不指望收麦实，而是当春天小麦、大麦长得青绿时，将其耕翻压死，在土里腐烂肥地，秋天收稻谷时产量必增加一倍。

麦收后的空地可再种其余作物。从初夏到秋末有近半年时间可因地制宜地选择种什么作物，由人决定。南方有在大麦收割后种晚熟粳稻的。农民的勤劳劳动总会得到报偿。荞麦在南方要在割完稻，北方在割完豆、稷以后才播种。荞麦的特性是吸收肥料较多，能使土瘦。然而要是算一下种荞麦的收入，已经抵偿原来收获的谷物的一半有余，勤农之家又何妨再施些肥呢。



must be ploughed and harrowed many times before sowing. The wheat seeds are first mixed with ashes of grass and then sown by hand. After being sown, the soil is pressed firmly to cover the seeds with the feet instead of using a donkey-pulled stone roller.

Weeding with a large wide-blade hoe is required after sowing. After wheat seedlings appear, frequent weeding is required (Some farmers weed as many as three to four times). With the weeds being removed, the fertilizer in the soil contributes wholly to the growth of wheat. The more diligent the farmer is, the fewer weeds remain, and this is the same both in the south and in the north. Farmers apply manure to the wheat fields before sowing, because fertilizing after sowing is not necessary. In the locality of Luoshui in Shaanxi Province, it is possible that pests will eat the wheat seeds. Therefore, the seeds are mixed with arsenic before sowing, whereas in the south the seeds are mixed with grass ashes. In the south farmers sometimes grow wheat to enrich the rice paddy fields, rather than for harvesting purposes. When the wheat or barley grows dark green, they plough it under the soil to let it rot. Consequently the output of rice in the next autumn will double.

The wheat fields can be used to plant other crops after the harvest in the half-year period from early summer to late autumn. Farmers are always rewarded for their hardwork. They can decide what crops to plant in the wheat fields according to the local land conditions. In the south, some farmers plant late-ripening round-grained non-glutinous rice after harvesting barley. Buckwheat is sown in the south after rice is harvested and in the north after beans and proso millet are harvested. Buckwheat, which requires rich fertilizer, makes the soil barren. However, if the increased output of buckwheat is taken into account, it is worthwhile to apply more manure to the fields.



【原文】

麦 灾

凡麦妨患，抵稻三分之一。播种以后，雪、霜、晴、潦皆非所计。麦性食水甚少，北土中春再沐雨水一升，则秀华成嘉粒矣。荆、扬以南唯患梅雨，倘成熟之时晴干旬日，则仓廩皆盈，不可胜食。扬州谚云“寸麦不怕尺水”，谓麦初长时，任水灭顶无伤；“尺麦只怕寸水”，谓成熟时寸水软根，倒茎沾泥，则麦粒尽烂于地面也。江南有雀一种，有肉无骨，飞食麦田，数盈千万。然不广及，罹害者数十里而止。江北蝗生，则大侵之岁也。

黍、稷、粱、粟

凡粮食，米而不粉者种类甚多。相去数百里，则色、味、形、质随方而变，大同小异，千百其名。北人唯以大米呼粳稻，其余概以

【今译】

麦 灾

麦所受的灾害只有稻的三分之一。播种以后，雪、霜、旱、涝都不必顾虑。麦的性质是需水甚少，北方在仲春时只要有一场透雨，就能开花结粒。荆州、扬州以南地区，只怕梅雨。如果在成熟期内连晴十天，就会麦粒满仓，吃也吃不完。扬州谚语说“寸麦不怕尺水”，这是说当麦子生长初期不怕水淹没顶；所谓“尺麦只怕寸水”，这是说麦子成熟期一寸深的水会将麦根泡软，麦秆倒在田里沾泥，则麦粒都烂在地里了。江南有一种雀，有肉无骨，成千上万地飞到麦田食麦。但为害不广，受害地区不过方圆几十里。可是江北蝗虫一出现，便是大灾之年了。

黍、稷、粱、粟

粮食作物中只碾成米而不磨成面的，有很多种类。相隔数百里，其颜色、味道、形状和品质便因地而变，大同小异，其名字以百千



Wheat Disasters

Disasters happening to wheat are only one third of those happening to rice. After wheat is sown, snow, frost, drought and waterlogging do not affect wheat. Wheat does not require much water. In the north, wheat will blossom and bear grain if there is a good rain in mid-spring. However, south of Jingzhou and Yangzhou, the intermittent drizzle in the rainy season in late spring and early summer in the middle and lower reaches of the Yangtze River is harmful to wheat. If there are ten consecutive fine days during the ripening period, the grains of wheat will grow to the fullest and abundant food is assured. A saying in Yangzhou goes: “A *cun* high wheat is not afraid of a *chi* deep water”. This means that during the beginning stage of the growing period, abundant water is not a problem. However, the saying “A *chi* high wheat is afraid of a *cun* deep water” means that during the ripening period even a *cun* deep water will make the wheat roots loosen, and therefore, the wheat straw will fall into the muddy fields and the wheat grains will rot. A kind of fat sparrows south of the Yangtze River flock to the wheat fields for food. These sparrows affect an area of no more than a circumference of tens of *li*. But in the north of the Yangtze River, if locusts appear, it will be definitely a disastrous year.

Millet, Proso Millet and Foxtail Millet and the Like

There are many kinds of food crops which can only be ground into shelled or husked seeds instead of powder. The colour, taste, shape and quality of these food crops are different from place to place within an area of a hundred *li*. But they are more or less the same though they have hundreds of different names. People in the north consider the



【原文】

小米名之。凡黍与稷同类，粱与粟同类。黍有黏有不黏（黏者为酒），稷有粳无黏。凡黏黍、黏粟统名曰秫，非二种外更有秫也。黍色赤、白、黄、黑皆有，而或专以黑色为稷，未是。至以稷米为先他谷熟，堪供祭祀，则当以早熟者为稷，则近之矣。

凡黍在《诗》、《书》，有藿、芑、秬、秠等名；在今方语，有牛毛、燕颌、马革、驴皮、稻尾等名。种以三月为上时，五月熟；四月为中时，七月熟；五月为下时，八月熟。扬花、结穗总与来、牟不相见也。凡黍粒大小，总视土地肥饶、时令害育。宋儒拘定以某方黍定律，未是也。

凡粟与粱，统名黄米，黏粟可为酒。而芦粟一种，名曰高粱者，以其身长七尺如芦、荻也。粱粟种类名号之多，视黍稷犹甚。其命名或因姓氏、山水，或以形似、时令，总之不可枚举。山东人唯以

【今译】

计。北方人只将粳稻称为大米，其余的都叫小米。黍与稷是同类，粱与粟也是同类。黍有黏的，也有不黏的（黏的可以酿酒）。稷只有不黏的，没有黏的。黏黍与黏粟统称为秫，并非除这两种外还有另一种秫。黍的颜色红、白、黄、黑都有，有人专将黑色的叫做稷，这是不正确的。更有因为稷米比其余谷早熟以供作祭祀，因此应将早熟的叫稷，这种说法还差不多。

在《诗经》、《书经》里，黍有藿、芑、秬、秠等名称，而现在方言中又有牛毛、燕颌、马革、驴皮、稻尾等名。黍最早在三月播种，五月成熟。其次是在四月下种，则七月成熟。五月播种是最迟的时间，要到八月才成熟。其开花、结穗总是与大麦、小麦不在同一时间。黍粒大小总由土地肥瘦、时令好坏而定。宋儒刻板地以某一地方的黍粒作为度量的标准，未必是正确的。

粟与粱统称为黄米，黏粟可以造酒。另有一种芦粟，名为高粱，因为秆长七尺如芦、荻。粱、粟的种类和名号，比黍、稷还要多。其命名或因姓氏、山川，或根据形状、时令，总之，不胜枚举。山东人只叫做谷子，而不知粱、粟之名。以上四种粮食，都是春种秋



round-grained non-glutinous food crop as rice, and regard the rest of the varieties as millet. For example, millet and proso millet are in the same category. Millet can be glutinous or non-glutinous (the glutinous millet can be used to brew wines). Proso millet is non-glutinous. Glutinous millet and foxtail millet are called *shu*. *Shu* can be white, red, yellow or black. Some people call the black *shu* proso millet, which is incorrect. Proso millet ripens earlier than other food crops and is used for memorial services. Therefore, this kind of early-ripening crop is called proso millet.

In the classic *The Book of Poetry* and *The Book of History*, millet has different names like *qi*, *ju*, *pi*, while in modern dialect it is called ox hair, swallow's cheek, horsehide, donkey skin, rice tail, and so on. The earliest millet is sown in March and it ripens in May; if it is sown in April, it ripens in July. The latest sowing of millet will be in May and it ripens in August. The blossoming and fruit-bearing of millet are different from barley and wheat. The size of millet grains depends on the fertility of the soil and whether it is planted at the right time. It is inappropriate that the scholars in the Song Dynasty rigidly use the grains of millet of a particular locality as a standard to judge the quality of all millet produced everywhere.

Foxtail millet and millet are both referred to as coarse rice and glutinous millet which can be used for brewing wine. Another kind of millet is called sorghum because its stalk is seven *chi* high like reeds and *Amur silvergrass*. Sorghum and millet are of more types and have more names than millet and proso millet. They are named after a surname, a mountain or a river, or named after its shape, or the time when it is planted. People in Shandong Province call sorghum and millet grains. All these crops are sown in the spring and harvested in the au-



【原文】

谷子呼之，并不知粱粟之名也。以上四米，皆春种秋获。耕耨之法与来、牟同，而种收之候则相悬绝云。

麻

凡麻可粒、可油者，唯火麻、胡麻二种。胡麻即脂麻，相传西汉始自大宛来。古者以麻为五谷之一，若专以火麻当之，义岂有当哉？窃意《诗》、《书》五谷之麻，或其种已灭，或即菽、粟之中别种，而渐讹其名号，皆未可知也。

今胡麻味美而功高，即以冠百谷不为过。火麻子粒压油无多，皮为疏恶布，其值几何？胡麻数龠充肠，移时不馁。粃饵、饴飴得粘其粒，味高而品贵。其为油也，发得之而泽，腹得之而膏，腥膻得之而芳，毒疔得之而解。农家能广种，厚实可胜言哉。

种胡麻法，或治畦圃，或垄田亩，土碎、草净之极，然后以地灰

【今译】

收。而其耕锄方法与大麦、小麦相同，但播种与收获的时间就相差悬殊了。

麻

麻类中既可作粮食又可作油料的，只有大麻和芝麻这两种。芝麻就是脂麻，相传是西汉时开始从大宛国传入的。古时把麻列为五谷之一。如果专指大麻，怎能说是恰当呢？愚意以为《诗经》、《书经》所说五谷中的麻，或者是后来已经绝种的，或者是豆、粟中的别种，名称逐渐以讹传讹，亦未可知。

现在的芝麻味道好、功用大，即使将其列为百谷之首也不过分。大麻子榨油出油不多，其皮织成粗麻布，能有多少价值？而吃上一些芝麻，长时间不会饿。糕饼、糖果粘上芝麻，则味美而品贵。用芝麻油抹在头发上会发亮，食入腹内则增加滋养，放在腥膻食物里会发出香味，涂在毒疮上能解毒。农家要是多种些芝麻，好处真是说也说不完。

种芝麻方法，或在田里做畦，或者培田垄，必须土很碎并除去杂



turnn. The way they are sown and weeded are the same as that of barley and wheat, but the time of sowing and harvesting is quite different.

Hemp

In the hemp category, in the broadest sense, only hemp and sesame can be used for food and oil. Sesame is said to have been introduced from Ferghana during the Western Han Dynasty. In ancient times hemp was regarded as one of the five food crops. Therefore it is a misunderstanding if only a hemp itself is meant. I believe hemp was as one of the five food crops mentioned in *The Book of Poetry* and *The Book of History* and that hemp is extinct now. The different names for beans and millet are all mistaken and we do not know the reasons for this.

Sesame seeds taste good and have many uses, thus they top the list of the hundred kinds of food crops. Hemp seeds do not produce much oil and the outer covering is used to make coarse hemp fabrics. Therefore, hemp is ranked below sesame. If you eat some sesame seeds, you will not be hungry for a long time. If you coat thin pancakes and candies with sesame seeds, they will taste good and be more nutritious. Applying sesame oil to the hair makes the hair shine; eating it nourishes one's body; applying it to smelly food (for example fish and mutton) makes the food smell aromatic; and applying it to malignant festers detoxifies them. Farming families should plant more sesame because of the above-mentioned benefits.

The method of planting sesame is as follows: make farm plots surrounded by ridges or make ridges for planting sesame. The soil must be well pulverized and free from weeds. Mix sesame seeds with the slightly dampened ashes of grass and then sow them in the fields. Sowing



【原文】

微湿，拌匀麻子而撒种之。早春三月种，迟者不出大暑前。早种者花实亦待中秋乃结。耨草之功唯锄是视。其色有黑、白、赤三者。其结角长寸许，有四棱者房小而子少，八棱者房大而子多，皆因肥瘠所致，非种性也。收子榨油每石得四十斤余，其枯用以肥田。若饥荒之年，则留人食。

菽

凡菽种类之多，与稻、黍相等。播种、收获之期四季相承。果腹之功，在人日用，盖与饮食相终始。一种大豆有黑、黄二色，下种不出清明前后。黄者有五月黄、六月爆、冬黄三种。五月黄收粒少，而冬黄必倍之。黑者刻期八月收，淮北长征骡马必食黑豆，筋力乃强。

凡大豆视土地肥磽、耨草勤怠、雨露足慳，分收入多少。凡为豉、为酱、为腐，皆大豆中取质焉。江南又有高脚黄，六月刈早稻方

【今译】

草，然后将草木灰稍微湿润一下，与芝麻种子拌匀，撒播在田里。早春三月下种，最迟也不能在大暑以后。早种的芝麻也要到中秋开花结实。除草全靠用锄。其色有黑、白、红三种。所结的蒴果长一寸左右，呈四棱形的房小而粒少，八棱的房大而粒多。这都是由土地的肥瘠造成的，与种性无关。芝麻收子榨油后，每石得油四十余斤，其枯饼用以肥田。如遇饥荒之年，则留供人食。

菽

豆类的种类与稻、黍一样多。播种、收获的时间，持续在一年四季内。作为日常生活的食物，豆类的功用始终是与饮食分不开的。有一种大豆，分黑、黄两种颜色，下种期不外是清明前后。黄豆有“五月黄”、“六月爆”、“冬黄”三种。五月黄收粒少，而冬黄则多一倍。黑豆要到八月收获。淮北跑长途的骡、马，必定要吃黑豆才能筋强力壮。

大豆收获多少，取决于土地的肥瘠、除草的勤惰、雨水的多少。做豆豉、豆酱、豆腐，都以大豆为原料。江南又有一种“高脚黄”，



can be carried out as early as March in the early spring, but no later than after the Greater Heat. The early-sown sesame blossoms and bears fruit in mid-autumn. The fields are weeded by using hoes. Sesame is of three colors: black, white and red. The capsule containing the seeds is one *cun* long, the tetragonal capsule contains fewer seeds due to its smaller capacity and the octagonal capsule contains more seeds due to its larger capacity. The output depends on the soil quality and has nothing to do with the seeds. When pressed for oil, a hectoliter of sesame seeds produces over twenty kilograms of oil. The oil cake can be used as fertilizer. In times of famine, people can eat oil cakes as food.

Beans

There are as many kinds of beans as there are of rice and millet. The sowing and harvesting occur anytime throughout a year. Beans have become an integral part of the daily diet. There is a kind of bean which can be further divided into black soybeans and soybeans, which is sown around Pure Brightness. Soybeans are further divided into May soybeans, June soybeans, and winter soybeans. May soybeans have the lowest output, while the output of winter soybeans is twice as great as that of May soybeans. Black soybeans are harvested in August. The mules and horses which travel long distances north of the Huaihe River are fed black soybeans to maintain their strength.

The output of soybeans depends on the soil quality, the frequency of weeding, and the amount of rainfall. Soybeans are the raw materials for fermented soybeans, soybean sauce and bean curd. In the south of the Yangtze River, there are long-stalk soybeans, which are sown after the harvest of early season rice in June and harvested in September or



【原文】

再种，九十月收获。江西吉郡种法甚妙，其刈稻竟不耕垦，每禾稿头中拈豆三四粒，以指扱之，其稿凝露水以滋豆，豆性充发，复浸烂稿根以滋。已生苗之后，遇无雨亢干，则汲水一升以灌之。一灌之后，再耨之余，收获甚多。凡大豆入土未出芽时，防鸠雀害，驱之唯人。

一种绿豆，圆小如珠。绿豆必小暑方种，未及小暑而种，则其苗蔓延数尺，结荚甚稀。若过期至于处暑，则随时开花结荚，颗粒亦少。豆种亦有二：一曰摘绿，荚先老者先摘，人逐日而取之；一曰拔绿，则至期老足，竟亩拔取也。凡绿豆磨、澄、晒干为粉，荡片、搓索，食家珍贵。做粉洩浆灌田甚肥。凡蓄藏绿豆种子，或用地灰、石灰，或用马蓼，或用黄土拌收，则四五月间不愁空蛀。勤者逢晴频晒，亦免蛀。

凡已刈稻田，夏秋种绿豆，必长接斧柄，击碎土块，发生乃多。凡种绿豆，一日之内遇大雨扳土，则不复生。既生之后，防雨水浸，疏沟浚以泄之。凡耕绿豆及大豆田地，耒耜欲浅，不宜深入。盖豆质

【今译】

六月割早稻时下种，九十月收获。江西吉安地区的种法甚妙，收割后的稻田竟不耕垦，在稻茬中用手放入三四粒豆种。稻茬上凝聚的露水滋润着豆种，大豆发芽后又用浸烂的稻根来滋养。出苗之后，遇干旱无雨，要浇一升水。浇水后，再将杂草除去，收获必多。大豆种入土未出芽的时候，要防备鸠、雀为害，只有靠人去驱赶。

另一种绿豆，圆小如珠。绿豆必须在小暑时才能种，不到小暑便种，则其苗秧蔓延数尺长，结荚甚稀。如果过期到处暑时下种，则会随时开花结荚，豆粒亦少。绿豆也有两种：一种叫摘绿，豆荚先老的先摘，每天摘取；另一种叫拔绿，要到全都熟透后整亩地拔取。将绿豆磨成粉浆，澄去浆水，晒干成绿豆粉，再做成粉皮、粉条，便成为珍贵食品。做绿豆粉剩下的洩浆灌田甚肥。贮藏绿豆种子，或用草木灰、石灰，或用马蓼，或用黄土拌收，则四五月间不愁蛀空。勤者遇天晴经常晒一晒，也可避免虫蛀。

在已收割的稻田里夏秋时种绿豆，必须用长的斧柄去打碎土块，出苗才多。种绿豆的当天要是下大雨而土壤板结，就长不出苗了。生



October. In the locality of Ji'an in Jiangxi Province, soybean sowing is quite unique. The rice paddy fields are not turned over after the harvest. Three or four soybean seeds are put, by hand, onto the rice stubbles. The dew gathered on the stubble moistens the soybean seeds and the rotten stubble nourishes the soybean seeds. After the soybeans grow into seedlings, water them once in dry weather. Weeding is required to secure a good harvest. Before the soybean seeds grow into seedlings, farmers have to prevent the turtledoves and sparrows from eating the seeds.

Mung beans are as small as beads. They must not be planted until the Lesser Heat. If they are planted before that, the mung bean seedlings will grow a few *chi*, but bear few pods. If planting is delayed until the End of Heat, the beans will blossom and bear pods all the time, but the quantity is small. There are two kinds of mung beans. One is the ripe-and-pick type, which means farmers pick the ripened pods on a daily basis, while the other type is the ripe-and-pull type, which means farmers harvest the bean stalks when all the beans are ripe. Mung beans can be ground into bean milk and further ground into powder. The powder can be made into sheet jelly and flat noodles. The liquid waste left over in the process of making mung bean powder is used as fertilizer. For storage, mung bean seeds are mixed with ashes of grass, lime, knotweed or loess so that the seeds will not be eaten by worms. Diligent farmers often dry the seeds in fine weather to prevent them from being eaten by worms.

When planting mung beans in summer and autumn in rice paddy fields after rice is harvested, pound the lumps of earth with a long handle of an axe so that bean seedlings will grow well. If there is a heavy rainfall the day when the mung beans are planted, the soil will become



【原文】

根短而苗直，耕土既深，土块曲压，则不生者半矣。“深耕”二字不可施之菽类，此先农之所未发者。

一种豌豆，此豆有黑斑点，形圆同绿豆，而大则过之。其种十月下，来年五月收。凡树木叶〔落〕迟者，其下亦可种。一种蚕豆，其荚似蚕形，豆粒大于大豆。八月下种，来年四月收，西浙桑树之下遍繁种之。盖凡物树叶遮露则不生，此豆与豌豆，树叶茂时彼已结荚而成实矣。襄、汉上流，此豆甚多而贱，果腹之功不啻黍稷也。

一种小豆，赤小豆入药有奇功，白小豆当餐助嘉谷。夏至下种，

【今译】

苗以后要防止雨水浸泡，要疏通垄沟排水。耕绿豆及大豆的田地，下犁要浅，不宜深入。因豆类根短而苗直，耕土深时豆苗被土块压弯，有一半不会生长。因此“深耕”二字不适用于豆类，这是先农们所不曾提到过的。

还有一种是豌豆，此豆上有黑斑点，形状像绿豆那样圆，但比绿豆大。十月下种，来年五月收。在落叶晚的树下也可种豌豆。另一种蚕豆，其豆荚类似蚕形，豆粒比大豆豆粒大。八月播种，来年四月收。浙江西部地区在桑树下普遍种蚕豆。所有作物被树叶遮盖都长不好，但蚕豆与豌豆在树叶茂盛时就已结荚成粒。襄河、汉水上游产蚕豆甚多也很便宜，作为粮食的功用不次于黍、稷。

小豆有赤小豆，入药有奇功，白小豆是掺在米饭里吃的好东西。小豆在夏至时播种，九月收获，在长江、淮河之间种得很多。另一



so hard that the seedlings can not push through the earth. After the seedlings appear, dredge the irrigation furrows in the fields to prevent the seedlings from being drowned. The mung bean and soybean fields are not to be ploughed deep. The beans do not have deep roots and the seedlings are straight. Lumps in deep ploughing bend the seedlings, and it is possible that up to half of them will not develop well. Therefore, deep ploughing is not suitable for beans, but it was not realized by farmers before now.

Peas, with black spots on them, are of the same shape as mung beans but are larger in size. They are planted in October and harvested in May of the following year. Peas can also be planted under trees whose leaves fall late. Broad bean pods look like silkworms and the grains are larger than soybeans. If they are planted in August, they will be harvested in April of the following year. In the western part of Zhejiang Province broad beans are extensively planted under mulberries. Broad beans and peas growing under trees begin to bear pods and grains even if the tree leaves are dense. But other crops cannot grow well under trees. In the upper reaches of the Xianghe and Hanshui rivers, broad beans are plentiful and therefore less expensive. Broad beans are no less significant than millet or proso millet in terms of their usefulness as food.

One kind of beans is red bean. Red beans have been used as medicine and proved effective. Both kinds of beans are cooked with rice. Both are sown at the Summer Solstice and harvested in September. They are widely planted in areas between the Yangtze and Huaishui rivers. Another kind of beans is called black lentil, which in the old days was a wild plant, but is now planted widely in the north. As a replacement for mung beans, they can be ground to make sheet



【原文】

九月收获，种盛江、淮之间。一种稽豆，此豆古者野生田间，今则北土盛种。成粉、荡皮可敌绿豆。燕京负贩者，终朝呼稽豆皮，则其产必多矣。一种白扁豆，乃沿篱蔓生者，一名峨眉豆。其他豇豆、虎斑豆、刀豆与大豆中分青皮、褐色之类，间繁一方者，犹不能尽述。皆充蔬、代谷，以粒蒸民者，博物者其可忽诸！

【今译】

种稽豆，古时野生在田野里，现在北方种得很多，磨成粉做粉皮可顶绿豆。北京小贩整天吆喝稽豆皮，可见其产量必不少。还有一种白扁豆，是沿着篱笆蔓生的，又名峨眉豆。其余如豇豆、虎斑豆、刀豆以及大豆中的青皮、褐色之类，只种植在某一地区的，就不能尽述了。豆类都可充作菜蔬或代替粮食以供百姓食用，博物学者怎么能忽视呢！

jelly. Pedlars in Beijing sell sheet jelly from street to street which indicates its large output. White hyacinth beans, also called eye-brow beans, grow along fences. There are other kinds of beans, such as cow-peas, tiger-spot beans, knife-shape beans, black-color soybeans, and brown-color soybeans which are planted in certain areas, to name just a few. Beans can be used as vegetables or the main food. No wonder naturalists value them.





粹精 第二

【原文】

宋子曰，天生五谷以育民，美在其中，有“黄裳”之意焉。稻以糠为甲，麦以麸为衣。粟、粱、黍、稷，毛羽隐焉。播精而择粹，其道宁终秘也。饮食而知味者，食不厌精。杵臼之利，万民以济，盖取诸《小过》。为此者，岂非人貌而天者哉？

攻 稻

凡稻刈获之后，离稿取粒。束稿于手而击取者半，聚稿于场而曳牛滚石以取者半。凡束手而击者，受击之物或用木桶，或用石板收获之时雨多霁少，田稻交湿不可登场者，以木桶就田击取。晴霁稻干，则用石板甚便也。

【今译】

宋子说，自然界生长五谷以养育人，而谷粒包藏在黄色谷壳里，像身披“黄裳”一样美。稻以糠为壳，麦以麸为皮。粟、粱、黍、稷的子实都隐藏在毛羽里面。去掉皮壳而得精白的米、面就食，这种道理是显而易见的。讲求饮食味道的人，粮食不嫌舂得精，鱼肉不嫌切得细。加工谷物的杵臼，其功用有益于万民，盖取自《小过》的卦象原理。发明这类技术的人，怎能是一般人而不是天才人物呢？

稻谷加工

水稻收割之后，要脱秆取粒。手握一把稻秆击取稻粒的占一半，将稻都放在场上以牛拉石碾碾取稻粒的也占一半。以手击取稻粒，被击之物或用木桶，或用石板。收获时如雨天多晴天少，田间和水稻都湿，则不可上场，便用木桶在田间就地击取。晴天稻干，则用石板击稻更为方便。



Chapter 2

Rice and Wheat

Songzi says that Nature provides five types of grains to nourish people. Grains are hidden in the yellow chaff, and look as beautiful as if they were in yellow robes. Rice is covered in chaff, wheat is enclosed by bran, and millet and sorghum grains are hidden in featherlike husks. It is obvious that people can get fine and polished rice and flour by getting rid of their impurities. For those who are particularly interested in the flavor of food nothing can be too refined. Pestle and mortar are used to grind and polish cereals and are useful to everyone. The desire of refining results in an excessive use of small and humble tools such as the pestle and mortar. How can the inventors be common people? In fact they are geniuses.

The Processing of Rice

Rice grains are removed from their stalks after harvest. Half of the rice grains can be obtained by thrashing the stalks on something, and the other half can be obtained by spreading the rice stalks on the ground and passing over them with an ox-drawn stone roller. Hold a handful of rice stalks in hand and thrash them on a cask or on a slate. If there are more rainy days and fewer sunny days during the harvest season, both the field and the rice will be wet. Therefore, the rice cannot be put on the ground. In this case, thrash the rice stalks on the inside of the cask in the field right after harvest. If it is sunny and the rice is dry, it is more convenient to thrash the rice stalks on the slate.



湿田击稻

Rice thrashing in the wet rice field



稻場击稻

Rice thrashing on dry ground



【原文】

凡服牛曳石滚压场中，视人手击取者力省三倍。但作种之谷恐磨去壳尖，减削生机，故南方多种之家，场禾多借牛力，而来年作种者，宁向石板击取也。凡稻最佳者，九穰一秕。倘风雨不时，耘耔失节，则六穰四秕者容有之。凡去秕，南方尽用风车扇去。北方稻少，用扬法，即以扬麦、黍者扬稻，盖不若风车之便也。

凡稻去壳用砬，去膜用舂、用碾。然水碓主舂则兼并砬功，燥干之谷入碾亦省砬也。凡砬有二种，一用木为之，截木尺许（质多用松），斫合成大磨形，两扇皆凿纵斜齿，下合植樵穿贯上合，空中受谷。木砬攻米二千余石其身乃尽。凡木砬，谷不甚燥者入砬亦不碎，故人贡军国、漕储千万，皆出此中也。一土砬，析竹匡围成圈，实

【今译】

用牛拉石碾压场脱粒，比以手击稻省力三倍。但留作种子的稻谷，恐怕会磨去稻壳壳尖而减少发芽机会，所以南方种稻多的农家在场上脱谷多借牛力，而来年作稻种的则宁取用石板击取的。最好的稻谷每十棵中有九棵是颗粒丰满的，只有一棵是谷粒不饱满的。倘风雨不调，壅根拔草不及时，则间或有六棵粒满、四棵谷粒不饱满。去掉秕子时，南方都用风车扇去。北方稻少，则用扬场的方法，就是用扬麦、扬黍的方法来扬稻，但不如风车方便。

稻谷去壳用砬，去皮用舂、用碾。用水碓舂谷，则兼有砬的功用，干燥的稻用碾加工也可不用砬。砬有两种，一种用木做成，截木一尺许（多用松木），加工成大磨形状，两扇都凿出纵斜齿，下扇用樵与上扇接合，谷从上扇孔中进入。木砬磨米二千余石后便已损坏。用木砬时，不甚干燥的稻谷，加工后也不会磨碎。因此上缴的军粮、官粮，漕运或库存以千万石计，都用木砬加工。另一种是土砬，剖



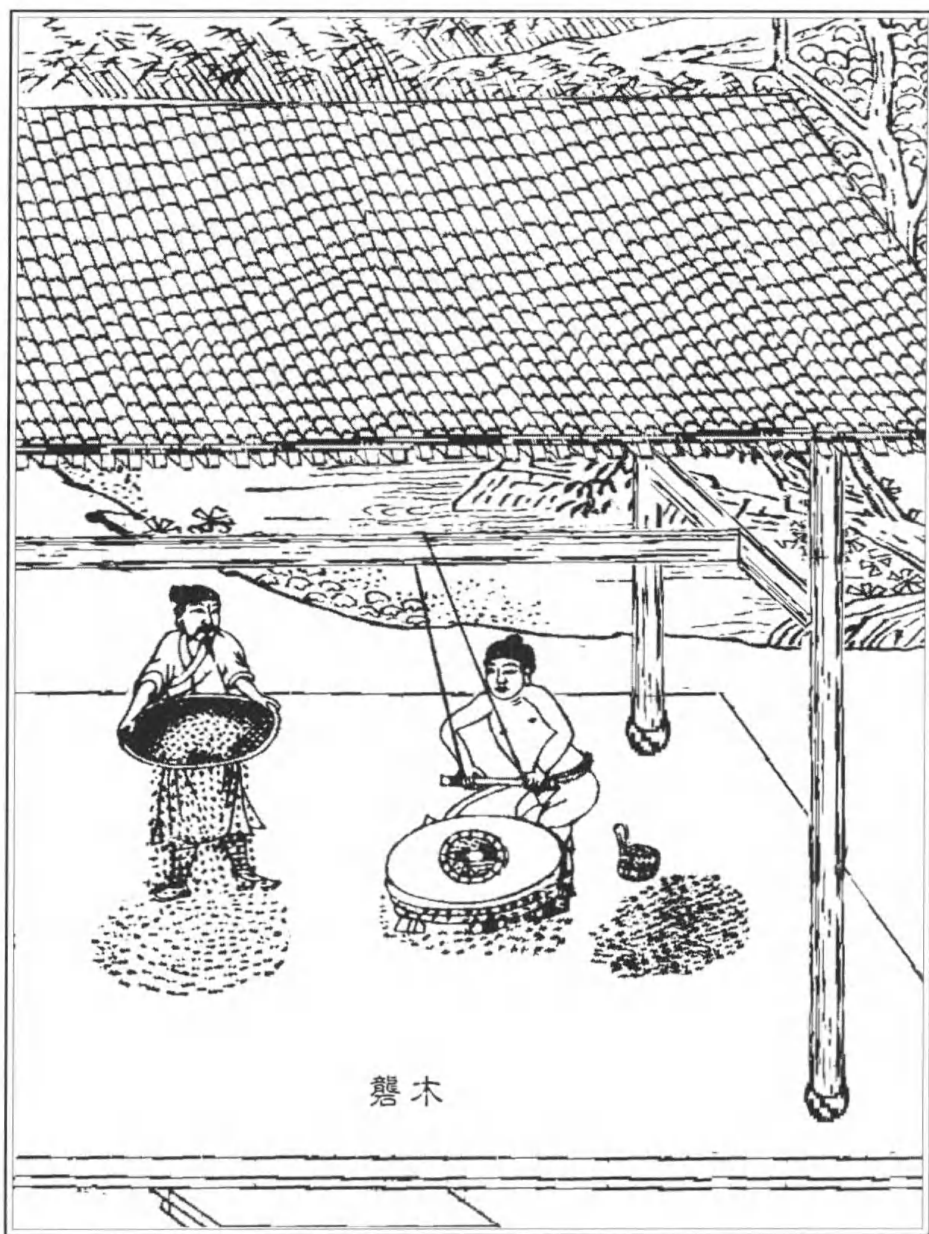
Obtaining rice grains with an ox-drawn stone roller requires only one-third of the human labor required by thrashing with hands. However, using a stone roller has the danger of damaging the tip of rice grains and thus reducing the chance of germinating. Farmers in the south who grow plentiful rice use an ox-drawn stone roller to obtain rice grains from the stalks. But they thrash rice stalks on slates to get seed rice for next year's planting. In the best rice there are nine full grains out of ten and only one is blighted. If the weather is not favorable, or the roots are not heaped in time or the weeds are not pulled out in time, there will be some rice grains of poor quality. There will be six full grains and four blighted grains. People in the south use winnowers to blow off blighted grains. Less rice is planted in the north. People winnow rice by hand, the same way they winnow wheat and millet, but it is not as convenient as using a winnower.

People use a *long*, which is a rice huller like a stone mill, to remove the rice husks. They use pestles and rollers to grind rice. People can also hull rice with a mill, a treadle-operated tilt hammer for hulling rice. Dry rice can be processed by rollers without using the *longs*. There are two kinds of *longs*: one is made of wood, mostly pine. The wood is sawed into pieces of one *chi* long, and built into the shape of stone mills. The inner faces of the two circular blocks are both marked with diagonal grooves. The protruding center of the lower block is inserted into the upper block. The unhusked rice is fed into the hole in the middle of the upper block. The wooden *long* is worn out after hulling over two thousand *dan* of rice. When using a wooden *long*, the rice grains which are not totally dry will not be damaged. Therefore, thousands of *dan* of rice prepared by using the wooden *long* can be supplied to the army and government in the form of taxes. The other



赶稻及菽

Obtaining rice grains with an ox-drawn roller



木磑
The wooden *long*



【原文】

洁净黄土于内，上下两面各嵌竹齿。上合笕空受谷，其量倍于木碄。谷稍滋湿者，入其中即碎断。土碄攻米二百石其身乃朽。凡木碄必用健夫，土碄即孱妇弱子可胜其任。庶民饔飧皆出此中也。

凡既碄，则风扇以去糠粃，倾入筛中团转。谷未剖破者，浮出筛面，重复入碄。凡筛大者围五尺，小者半之。大者其中心偃隆而起，健夫利用。小者弦高二寸，其中平洼，妇子所需也。凡稻米既筛之后，入臼而舂，臼亦两种。八口以上之家，掘地藏石臼其上。臼量大者容五斗，小者半之。横木穿插碓头（碓嘴冶铁为之，用醋滓合上），足踏其末而舂之。不及则粗，太过则粉，精粮从此出焉。晨炊无多者，断木为手杵，其臼或木或石以受舂也。既舂以后，皮膜成粉，名曰细糠，以供犬豕之豢。荒歉之岁人亦可食也。细糠随风扇播扬

【今译】

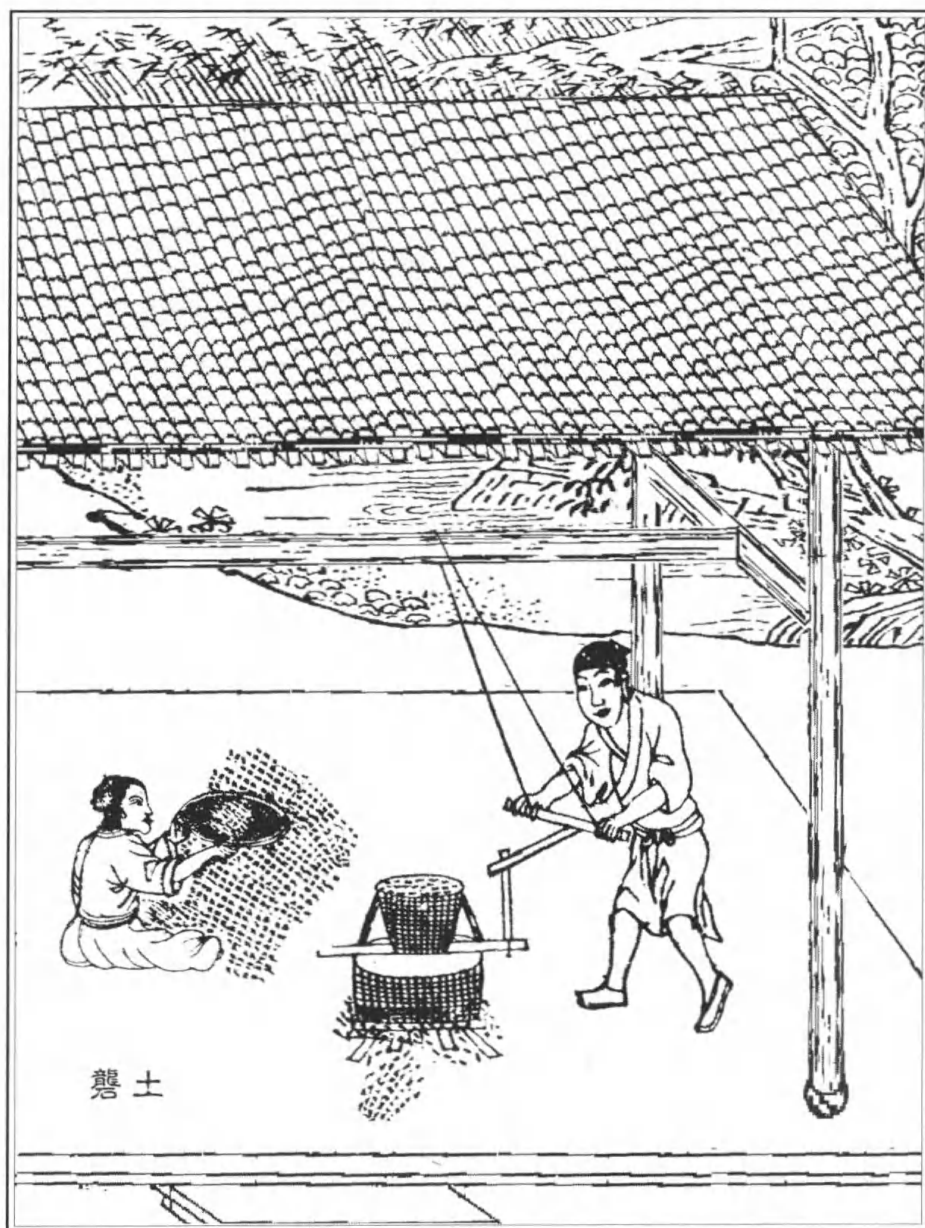
竹编成圆筐，其中实以干净的黄土，上下两扇各镶上竹齿。上扇装竹篾漏斗受谷，其量为木碄的两倍。稻谷稍湿时，入土碄中即碎断。土碄磨米二百石后便不堪用。木碄必用壮劳力，土碄则妇女儿童亦可胜任。百姓食米都用土碄加工。

经碄磨脱壳后，稻谷用风车去掉糠粃，再倒入筛中团团转动。没有破壳的稻谷浮出筛面，重新倒入碄中。大筛周围五尺，小筛减半。大筛中心稍隆起，壮者使用。小筛边高二寸，中心稍凹，妇女使用。稻米过筛后，入臼舂捣，臼亦有两种。八口以上之家，掘地埋上石臼。大白可盛五斗，小白减半。横木插入碓头（碓嘴以铁做成，用醋滓黏合），用脚踏横木末端舂捣。舂得不足，则米质粗，舂过分则米碎成粉。精米都用白加工出来。吃粮不多之户，用木做手杵，其臼或用木制或用石制用来舂捣。舂后的稻谷皮膜变成粉，名曰细糠，用以饲



kind is a loess *long*. Bamboo is cut open and weaved into a round basket. Fill the gaps with loess and fix bamboo teeth on both baskets. There should be a bamboo funnel in the upper basket holding the rice. The capacity is twice that of a wooden *long*. If the rice is a little moist, it will be broken into pieces right after the rice is put into the loess *long*. The loess *long* will be worn out after hulling about two hundred *dan* of rice. It requires strong men to handle the loess *long*, while the wooden *long* can easily be handled by women or children. Rice eaten by common people is usually processed with a loess *long*.

After hulling rice grains with a *long*, people use a winnower to remove chaff and blighted grains, and then pour them into a sieve and turn it. The rice grains that have not been hulled come to the surface and are poured into the *long* again. Big sieves have a circumference of five *chi* and small sieves are only half this size. The center of the big sieve hunches a little and only strong men can use it. The small sieves are two *cun* high on the side and sunken a little in the center, and women can use them. After being sieved, the rice grains are poured into a mortar to be pounded. There are two types of mortars. A family of eight or more members digs a hole in the ground and fixes a stone mortar in the hole. Big mortars can hold five *dou* of rice, while small mortars can hold half of this amount. A crossbar is inserted into the head of a mill (the mouth of the mill is made of iron and is glued to the wooden part). The pounding mill is operated both by hand and foot. A farmer steps on the end of the crossbar to pound the rice. The rice will be coarse if it is not fully pounded, while it will be ground into powder if it is overdone. Good rice is all processed by using mortars. Those families which consume a smaller amount of rice use wood as a pestle, and the mortar is made of either wood or stone. If the husk of the rice



磬土

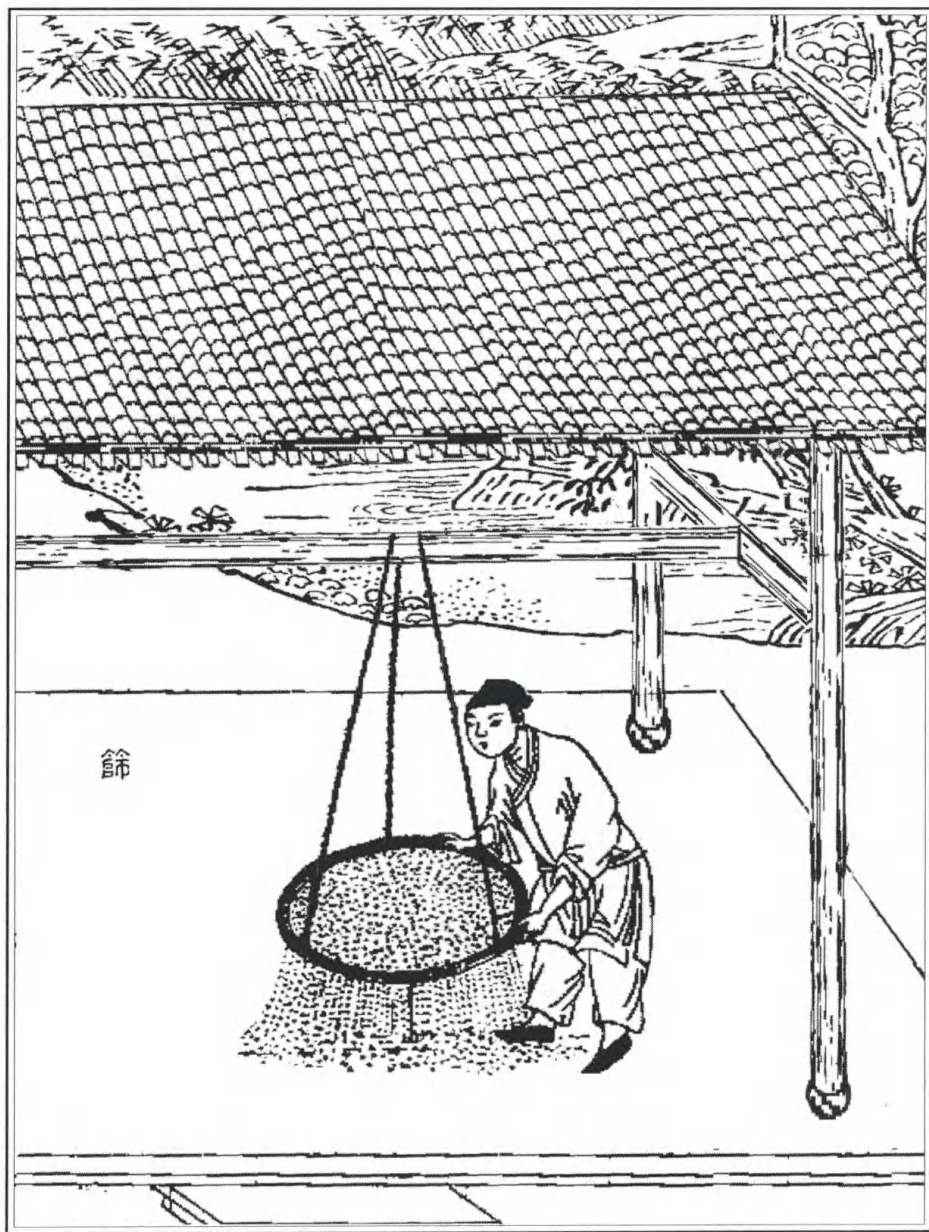
土磬

The loess long



风车

Separating husks with a winnowing machine



篩

The sieve



春

The foot-operated pounding mills



【原文】

分去，则膜尘净尽而粹精见矣。

凡水碓，山国之人居河滨者之所为也，攻稻之法省人力十倍，人乐为之。引水成功，即筒车灌田同一制度也。设臼多寡不一，值流水少而地窄者，或两三臼。流水洪而地室宽者，即并列十臼无忧也。江南信郡水碓之法巧绝。盖水碓所愁者，埋臼之地卑则洪潦为患，高则承流不及。信郡造法即以一舟为地，橛桩维之。筑土舟中，陷臼于其上。中流微堰石梁，而碓已造成，不烦楸木壅坡之力也。又有一举而三用者，激水转轮头，一节转磨成面，二节运碓成米，三节引水灌稻田。此心计无遗者之所为也。

凡河滨水碓之国，有老死不见砬者，去糠去膜皆以臼相终始。唯风筛之法则无不同也。凡碾砌石为之，承藉、转轮皆用石。牛犍、

【今译】

养猪狗。荒歉之年，人亦可食之。细糠随风车扬去，除尽皮膜、尘土后，便得到精白的米。

水碓是住在山区靠河边的人们所使用的，加工稻谷省人力十倍，人们都乐于使用。水碓的引水构件与灌田的筒车的引水构件有同样的结构。水碓上放臼的数目多少不一，如流水少而地狭窄，便置两三个臼。水流大而地宽阔，即使并列十个臼也没问题。江南广信府造水碓之法巧绝。因为水碓就怕埋臼的地势低会为洪水所淹，太高则水流不到。广信府造法是以一条船当地，打桩将船围住，船中填土埋臼。要是在河的中流填石筑坝，则安装水碓便无须打桩围堤了。更有一身而三用的水碓，激水转动轮轴，水碓的第一节转磨成面，第二节带动水碓舂米，第三节引水灌于稻田。这是考虑得十分周密的人制造出来的。

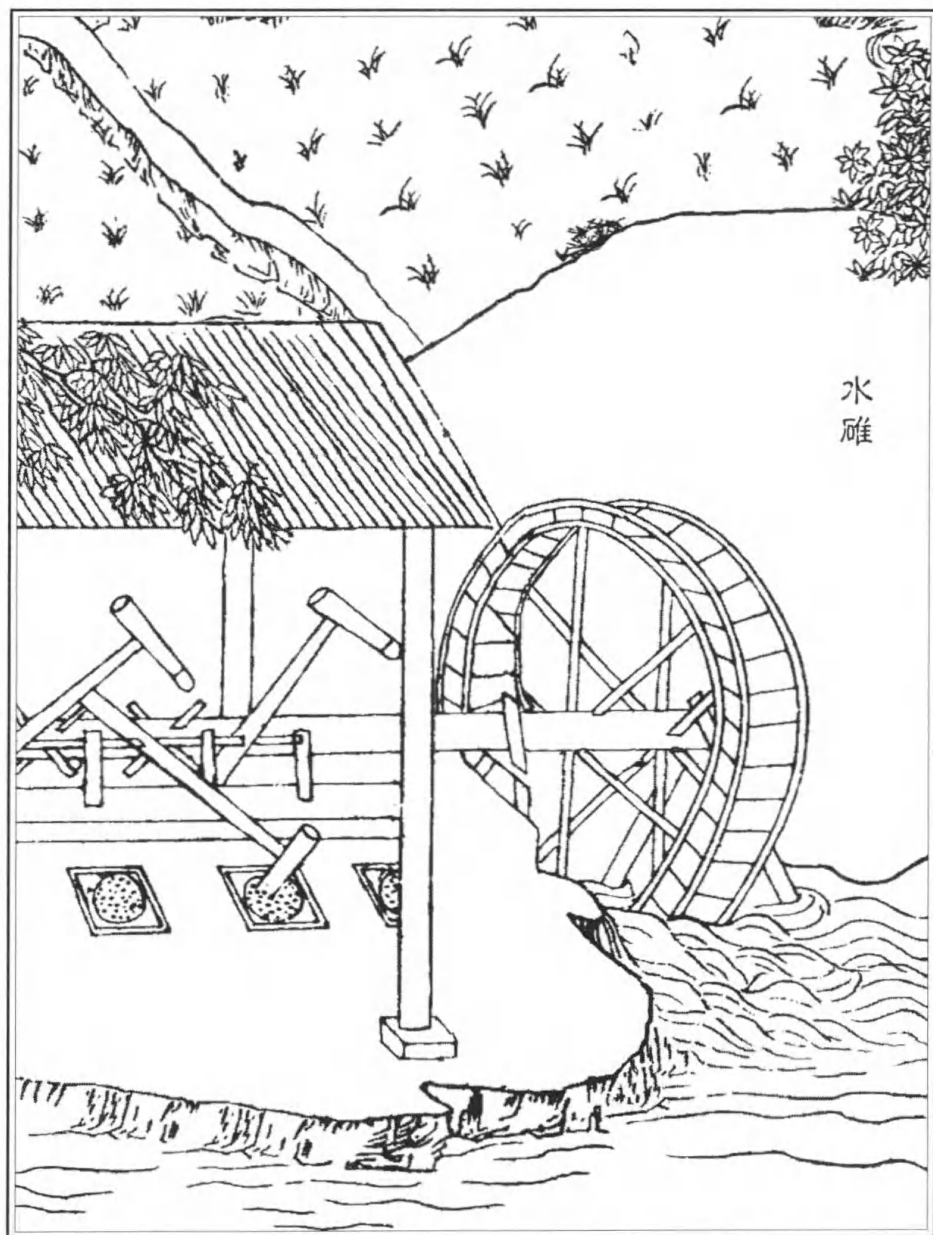
河滨用水碓地区有老死不见砬者，稻谷脱壳、去糠都始终用石臼。只有使用风车及过筛的方法，到处都一样。碾子以石砌成，碾



turns into powder after hulling, it is called fine chaff and is used to feed pigs or dogs. People also eat the fine chaff in times of famine. Fine rice is obtained after getting rid of the fine chaff and dust with a winnower.

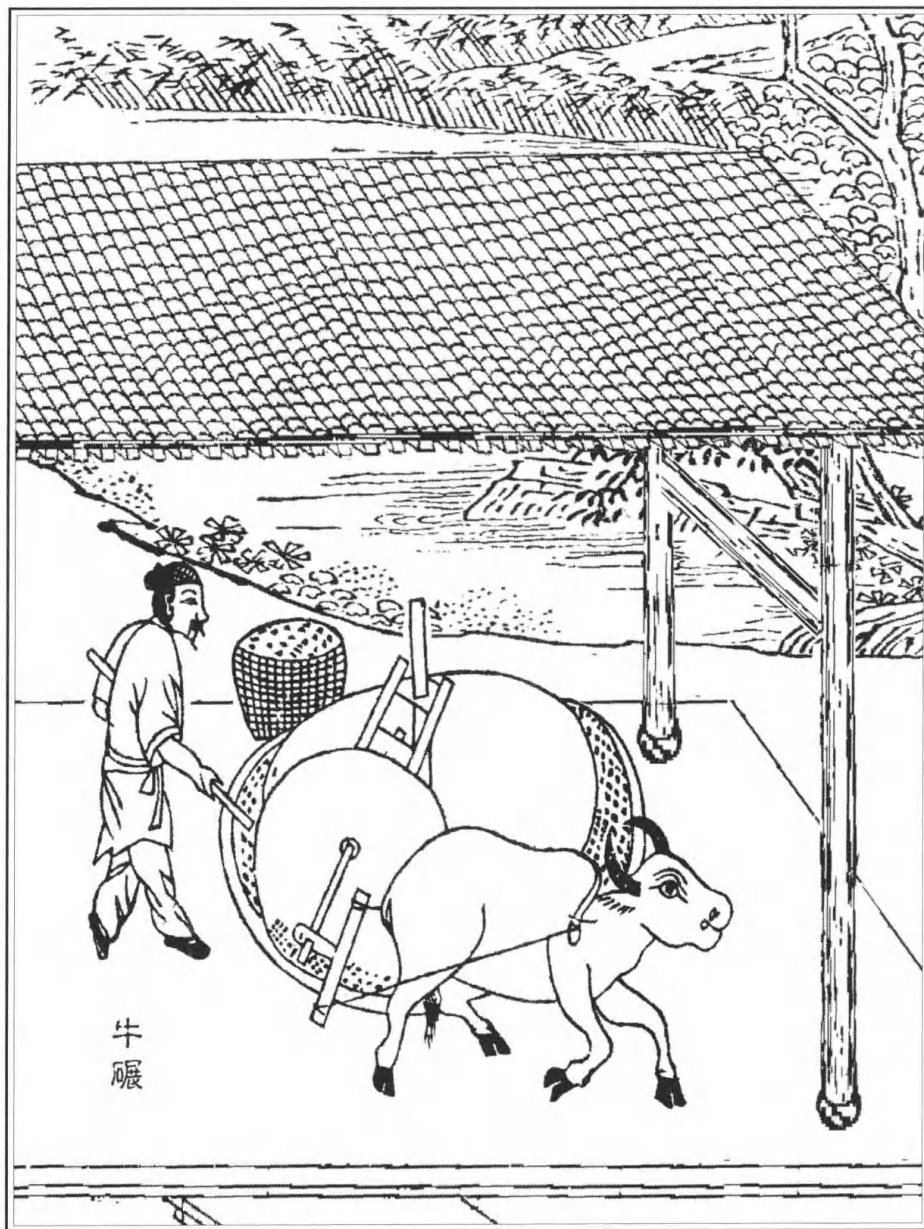
A water-powered mill is used by people who live beside rivers in the mountainous areas. It can save ten times the efforts when it is used to pound rice, so people all like to use it. The water-powered mill is constructed the same way as the cylinder wheels for irrigation. The number of mortars placed on the water-powered mill varies. People put two or three mortars in places where the water supply and the land area are limited. There is no problem placing ten mortars side by side where the volume of water is large and land is plentiful. The construction of a water-powered mill in Guangxin Prefecture, south of the Yangtze River is splendid. When the place in which the mortars are buried is low, the water-powered mill is submerged; when the place is too high, the current cannot reach it. The method for building a water-powered mill in Guangxin Prefecture is to use a boat as the base ground. The boat is secured by a wooden piling that surrounds it and is filled with earth in which the mortars are set. If a low stone dam across the current of the stream is built to provide water power, there is no need to build embankments of wood, earth and so forth. Another kind of water-powered mill has three functions. When the swift current sets the water wheel in motion, it turns the water-powered flour mill, the rice-pounding mill and a device for drawing water to irrigate rice paddy fields. Such a device can only be invented by an unusually clever mind.

Some people who live along rivers only use stone mortars to remove the husks and bran and never use the *longs*. But farmers use



水碓

The water-powered pounding mill



牛碾

The ox-drawn rolling mill



【原文】

马驹惟人所使。盖一牛之力，日可得五人。但入其中者必极燥之谷，稍润则碎断也。

攻 麦

凡小麦，其质为面。盖精之至者，稻中再舂之米；粹之至者，麦中重罗之面也。小麦收获时，束稿击取，如击稻法。其去秕法，北土用扬，盖风扇流传未遍率土也。凡扬不在宇下，必待风至而后为之。风不至，雨不收，皆不可为也。

凡小麦既扬之后，以水淘洗尘垢净尽，又复晒干，然后入磨。凡小麦有紫、黄二种，紫胜于黄。凡佳者每石得面一百二十斤，劣者损三分之一也。凡磨大小无定形，大者用肥犍力牛曳转。其牛曳磨时用桐壳掩眸，不然则眩晕。其腹系桶以盛遗，不然则秽也。次者用驴磨，斤两稍轻。又次小磨，则只用人推挨者。

凡力牛一日攻麦二石，驴半之，人则强者攻三斗，弱者半之。若

【今译】

盘、石碾皆用石。由人驱使牛犍或马驹拉碾。一牛之力，一日可抵五人。但入碾中的必须是极干燥的稻谷，稍湿则将米磨碎。

小 麦 加 工

小麦是面粉原料。稻谷加工后最精者是舂过两次的精米，小麦加工后最上品是重复罗过的细白面粉。收获小麦时，手握一把麦秆击取，其法如同击稻。去麦秕，在北方用扬场的方法，因为风车没有遍布全国各地。扬麦不能在屋檐下，必待风至而后为之。风不来、雨不停都不能扬麦。

小麦扬过之后，以水将尘垢淘洗净尽，再晒干，然后入磨。小麦有紫、黄两种，紫胜于黄。好麦每石得面一百二十斤，劣者少得三分之一。磨的大小没有固定形制，大磨用阉过的肥壮牛拉。牛拉磨时，用桐壳遮眼，不然则眩晕。牛腹下系桶以盛粪便，不然则不洁。小磨重量稍轻，用驴拉。再小的磨则只用人推。

用牛一日加工二石麦，用驴则加工一石，用人则强者一日加工三



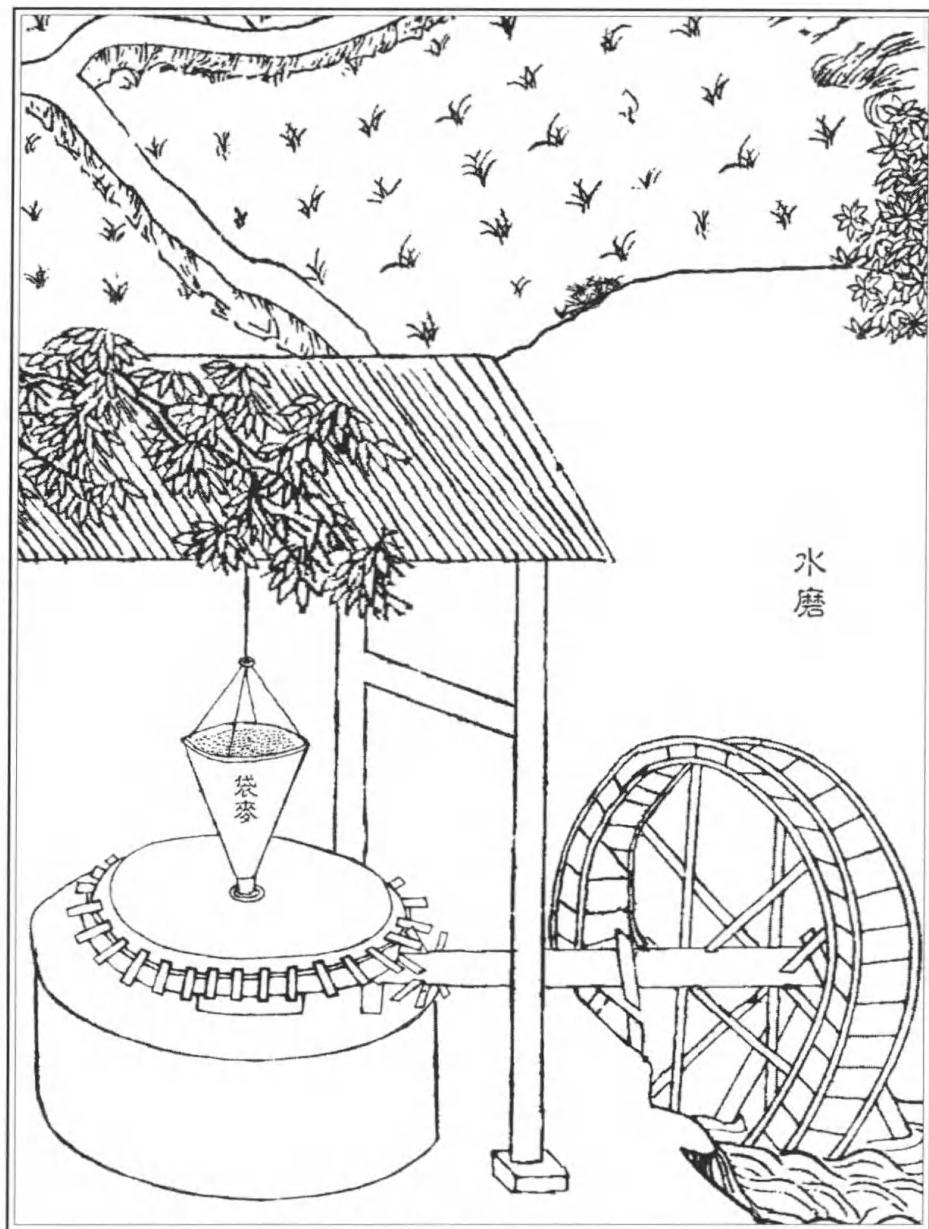
winnowers and sieves in the same way everywhere. A kind of hulling mill is made of stone, and the grinding base and the stone roller are both made of stones. People use calves or colts to turn the roller. One calf's work in a day equals the work of five men. But the rice which is put into the roller must be dry, otherwise the rice will be ground into powder if it is wet.

The Processing of Wheat

Wheat is the raw material for flour. The finest rice is obtained from the processing of unhusked rice by pounding it twice, while the top-quality wheat flour is obtained from the processing of wheat by sifting repeatedly. The way of reaping wheat by hand is the same as reaping rice. People in the north winnow wheat by hand, for the winnower is not widely used. Farmers can not winnow wheat under the eaves, and they have to wait till it is windy. Winnowing can't be done when there is no wind and when it is raining.

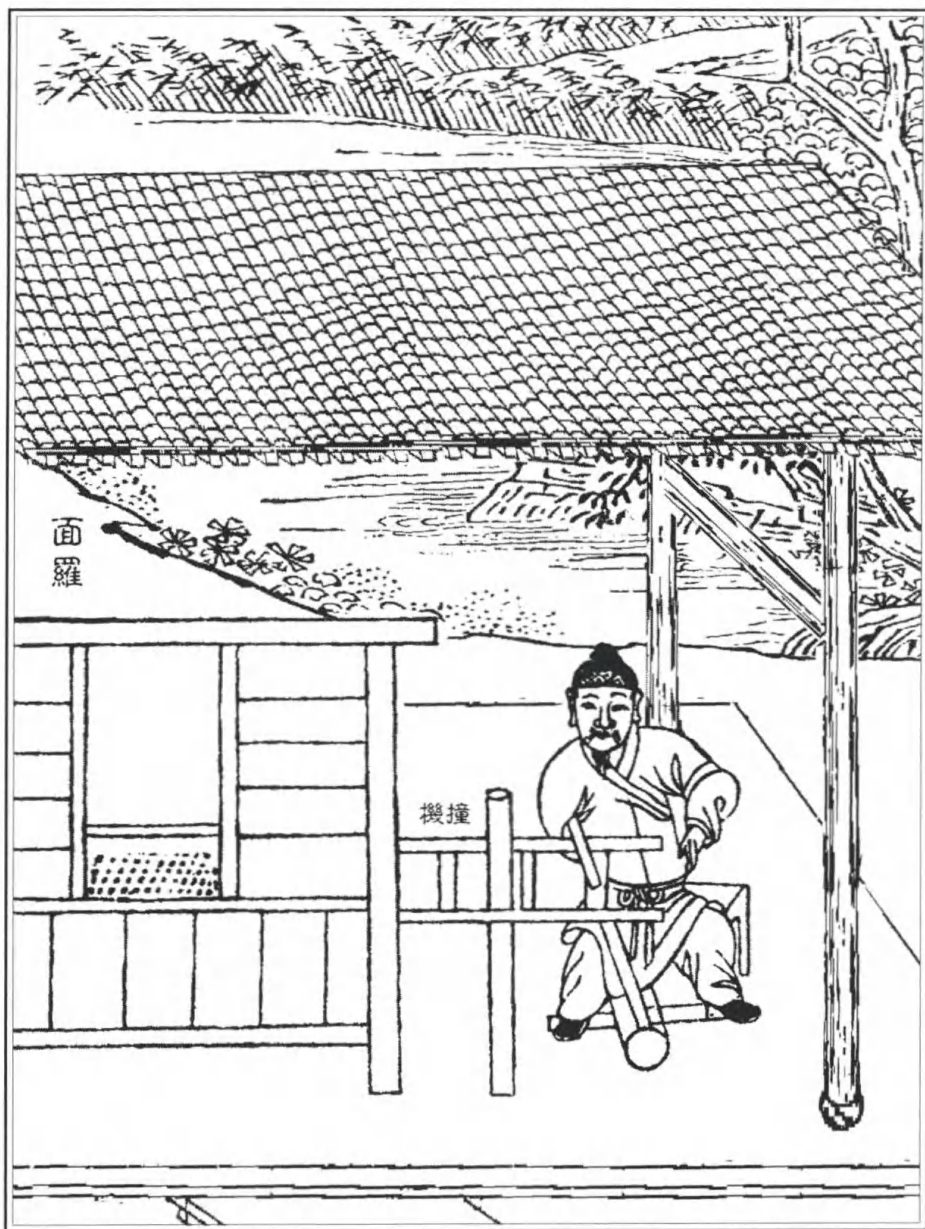
After being winnowed, the wheat is washed in water to get rid of the dust, dried in the sun and then ground. Wheat has two colors, purple and yellow; the purple wheat is better than the yellow one. Good wheat produces one hundred and twenty *jīn* of flour for every *dān* while the inferior wheat produces one third less. There is no fixed size for flour mills. The larger mills are turned by strong oxen. The eyes of the oxen are covered with the bark of candlenut, or they will become dizzy while turning the mills. A bucket is suspended from under the ox's belly to hold its dung and keep the wheat and flour clean. The small flour mills are light and easy to turn and thus are turned by donkeys. The even smaller ones can be pushed by humans.

An ox-drawn mill can grind two *dān* of wheat a day, a donkey-



水磨

The water-powered grinding mill



面罗
The flour bolter



【原文】

水磨之法，其详已载《攻稻·水碓》中，制度相同，其便利又三倍于牛犊也。凡牛、马与水磨，皆悬袋磨上，上宽下窄，贮麦数斗于中，溜入磨眼。人力所挨则不必也。

凡磨石有两种，面品由石而分。江南少粹白上面者，以石怀沙滓，相磨发烧，则其麸并破，故黑麸掺和面中，无从罗去也。江北石性冷腻，而产于池郡之九华山者美更甚。以此石制磨，石不发烧，其麸压至扁秕之极不破，则黑疵一毫不入，而面成至白也。凡江南磨二十日即断齿，江北者经半载方断。南磨破麸得面百斤，北磨只得八十斤，故上面之值增十之二，然面筋、小粉皆从彼磨出，则衡数已足，得值更多焉。

凡麦经磨之后，几番入罗，勤者不厌重复。罗框之底用丝织罗

【今译】

斗，弱者半之。水磨之法已详载《攻稻·水碓》节中，结构相同，其功效又三倍于牛犊。牛马拉的磨与水磨，都在磨上悬以上宽下窄的袋子，内装麦数斗，溜入磨眼。人力推动的磨则不必如此。

磨的石料有两种，面粉品质因石而异。江南很少细白上等面粉，因磨石石料含沙，相磨发热，则麦麸破碎，以致黑麸混入面中，无从罗去。江北石料性凉而细滑，产于池州府九华山的石料特别好。以此石制磨，石不发热，麦麸虽压得很扁，但不破裂，则黑麸皮一点也不混入，而面粉极白。江南磨用二十日即断齿，江北则半年方断齿。南方磨因磨破麸皮，每石得面百斤。北方磨只得八十斤，故上等面粉价格增加十分之二，然面筋、淀粉均从此磨磨出，则总产量不低，收入更多。

麦经磨之后，多次入罗，勤者不厌重复。罗框底用丝织绢制作。



drawn one can grind one *dan*, while a strong man can grind three *dou* and a weaker man can only grind half as much. Water-powered mills have been described above. The same method of grinding flour is employed, but is three times as efficient as an ox-drawn mill. Above an ox-, a horse- and a water-powered mill, a sack, wide at the top and narrow at the bottom, is suspended and a small hole is made in the bottom end. Wheat is poured into it and the wheat will drop into the hole of the mill. But this is not necessary when the mill is hand-operated.

The mills are made of two kinds of stones, and thus the quality of flour produced in this manner depends on the stone of the mill. There is little top-grade flour in the south of the Yangtze River because the stone mills there shed sand. The stones get hot when grinding, so the bran is broken and mixed with the flour and cannot be sifted out. Stones in the north of the Yangtze are cold, fine and smooth, especially stones produced in Chizhou Prefecture in Jiuhua Mountain. Mills made of this kind of stone will not get hot, the bran will not be broken even though it is pressed flat, and the black bran will not mix with the flour. The flour is extraordinarily white as a result. Mills in the south of the Yangtze will be worn out after twenty days of use, while mills in the north of the Yangtze will last as long as six months. What's more, mills in the south of the Yangtze produce a hundred *jin* of flour for every *dan*, as there is bran mixed in it, while mills in the north of the Yangtze River produce only eighty *jin* of flour. Therefore, the price will increase by twenty percent. But there is also gluten and starch included with the flour, so, in fact, the profit is even greater.

After being ground, the flour is poured into a sifter and sifted several times. The more it is sifted, the better. The bottom of the sifter is made of thin silk. Sifters made from silk in Huzhou Prefecture will re-



小碾

The hand-operated small rolling mill



打枷

Separating beans from the pods by beating with a flail

【原文】

地绢为之。湖丝所织者，罗面千石不损。若他方黄丝所为，经百石而已朽也。凡面既成后，寒天可经三月，春夏不出二十日即郁坏。为食适口，贵及时也。凡大麦则就春去膜，炊饭而食，为粉者十无一焉。荞麦则微加春杵去衣，然后或春或磨以成粉而后食之。盖此类之视小麦，精粗贵贱大径庭也。

攻黍、稷、粟、粱、麻、菽

凡攻治小米，扬得其实，春得其精，磨得其粹。风扬、车扇而外，簸法生焉。其法箴织为圆盘，铺米其中，挤匀扬播。轻者居前，簸弃地下。重者在后，嘉实存焉。凡小米春、磨、扬、播制器，已详《稻》、《麦》之中。唯小碾一制在《稻》、《麦》之外。北方攻小米者，家置石墩，中高边下，边沿不开槽。铺米墩上，妇子两人相向，接手而碾之。其碾石圆长如牛赶石，而两头插木柄。米堕边时，

【今译】

用湖州丝所制的罗底，罗面至千石亦不破。如用别处黄丝作罗底，则罗过百石即已坏损。面粉既成之后，寒冷天可放三个月，春夏则不出二十天即闷坏。为使食物适口，贵在及时食用。大麦春后去膜便可烧饭，磨成面粉的不到十分之一。荞麦微加春杵去皮，然后或春或磨做成荞麦粉后食之。这类粮食与小麦相比，质地精粗和价格贵贱就相差很远了。

黍、稷、粟、粱、麻、菽的加工

加工小米是扬得其粒，春得其米，磨得其粉。除风扬、车扇之外，还有一种方法是用簸箕。其法是用竹箴编成长圆形盘，将米铺入其中，挤匀扬簸。轻的扬到簸箕的前面，抛弃到地上。重的在后，都是米粒。加工小米用的春、磨、扬、播等工具，已详载于有关稻、麦加工的节中。只有小碾不载于加工稻、麦节中。北方加工小米，家中放一石墩，中间高、四边低，边沿不开槽。米铺在墩上，妇女两人面对面、相互手持石碾碾压。碾石是长圆形的，好像牛拉的石碾，而两



main in good condition after sifting a thousand *dan* of flour. However, sifters made from yellow silk in other places will wear out after grinding only a hundred *dan* of flour. The ready-to-eat flour can be stored for three months in cold weather. But in spring and summer, the flour will turn bad within twenty days. It is important to eat the flour promptly in order to ensure its taste. Barley can be cooked after pounding to remove its membrane. Less than ten percent of barley will be ground into flour. Buckwheat can be eaten after pounding to remove its hull or being ground down into flour. Buckwheat ranks far below wheat in quality and price.

The Processing of Millet, Sesame and Beans

Farmers winnow to get millets, pound them to get grains and grind them to get powder. Besides winnowing in the wind and using a winnower, there is another method, that is, shaking the millets with winnowing riddles. These bamboo strips are woven into an oblong pan like a riddle. Pour the millets into the pan, and shake them into the air. The lighter particles will fly to the front and fall to the ground, and the heavy particles that remain behind are the good full kernels. The methods for pounding, grinding and winnowing are the same as those for other grains and have been described in the section on rice and wheat. In addition, a small rolling mill is used to process millet in North China. A stone frustum whose center is higher than the edges is placed in the house. Millet is spread on the frustum, two women sit face to face and hold a stone roller to press and grind the millets in turn. The roller is cylindrical in shape and is much the same as the roller driven by an ox, but there are wooden handles on both ends. At the same time, when the millets fall to the edge, the millets should be immediately swept to



【原文】

随手以小彗扫上。家有此具，杵臼竟悬也。

凡胡麻刈获，于烈日中晒干，束为小把。两手执把相击，麻料旋落，承以簟席也。凡麻筛与米筛小者同形，而目密五倍。麻从目中落，叶残、角屑皆浮筛上而弃之。凡豆菽刈获，少者用枷，多而省力者仍铺场，烈日晒干，牛曳石赶而压落之。凡打豆枷竹木竿为柄，其端凿圆眼，拴木一条，长三尺许，铺豆于场，执柄而击之。凡豆击之后，用风扇扬去荚叶，筛以继之，嘉实洒然入廩矣。是故舂磨不及麻，碾碾不及菽也。

【今译】

头插木把。米碾到边沿时，随手以小笊帚扫上去。家中有此物，就无需杵臼了。

芝麻收割后，在烈日下晒干，捆成小把，两手执把相击，芝麻粒就会脱落，下面用竹席承接。芝麻筛与小的米筛形状相同，但筛眼比米筛密五倍。芝麻粒从筛眼中落下，将浮在筛上的残叶、角屑等弃掉。豆类收割后，少量的用打枷脱粒。数量多时，省力方法仍是铺在场上用烈日晒干，靠牛拉石碾来脱粒。打豆枷用竹、木杆为柄，其一端钻圆眼，拴上一条长约三尺的木棍。将豆铺在场上，执枷柄而击之。豆打落后，用风车扬去荚叶，接着过筛，得到的豆粒便可入仓了。因此芝麻用不着舂和磨，豆类用不着磨和碾。



the top with a small brush. There is no need to use any mortar and pestle when a household has such a stone roller at home.

After harvest, the sesame stalks are dried in the sun, and gathered into small bundles. Lay a bamboo mat on the ground to hold the sesame seeds. Hold one bundle at a time with both hands and beat it against a stone on top of the bamboo mat and the sesame seeds will come off easily. The sifter for sesame seeds has the same shape as the small rice sifter, but the gaps of the bottom are five times smaller. Sesame seeds fall down through the gaps, leaving bits of leaves and crumbs on the sifter, which are thrown away. After the reaping of the beans, farmers use a flail to get the beans from the stalks. When there is a large amount of the beans, they spread the stalks on the ground, let them dry in the sun, and then roll the beans off by using an ox-drawn stone roller. The flail is constructed by using a bamboo or wooden pole as the handle, by drilling a round hole in one end and tying another crabstick about three *chi* long. Spread the stalks on the ground and beat them with a flail. After that, farmers use a winnower to get rid of the remaining pods. Then after sifting in a sifter, the beans can be stored in a barn. Therefore, sesame seeds do not need to be pounded and ground and beans don't need to be ground.



作咸第三

【原文】

宋子曰，天有五气，是生五味。润下作咸，王访箕子而首闻其义焉。口之于味也，辛酸甘苦经年绝一无恙。独食盐禁戒旬日，则缚鸡胜匹，倦怠恢然。岂非天一生水，而此味为生人生气之源哉？四海之中，五服而外，为蔬为谷，皆有寂灭之乡，而斥卤则巧生以待。孰知其所以然？

盐 产

凡盐产最不一，海、池、井、土、崖、砂石，略分六种，而东夷树叶、西戎光明不与焉。赤县之内，海卤居十之八，而其二为井、

【今译】

宋子说，大自然有五行之气，由此又产生五味。五行中的水湿润而流动，具有盐的咸味。周武王访问箕子时，才首先得知关于五行的道理。人们吃的辣、酸、甜、苦四种味道的食物，经年缺少其中之一，都平安无事。唯独食盐，十日不吃，便身无缚鸡之力、疲倦不振。这不正好说明大自然产生水，而水中的盐质是人的活力的源泉吗？四海之内、边荒以外，都有不能种植蔬菜五谷的不毛之地，但食盐却巧妙地到处都出产，以待人取用。其原因何在呢？

盐的出产

盐的出产来源不一，大略可分为海盐、池盐、井盐、土盐、崖盐和砂石盐六种，而东北少数民族地区的树叶盐和西北少数民族地区的光明盐还没算在内。中国境内海盐产量占十分之八，而井盐、池



Chapter 3

Salt Making

Songzi says that there are five elements in nature, water, fire, wood, metal and earth, which are the basic elements of everything. They give birth to five tastes: salty, bitter, sour, spicy and sweet. Among the five elements water is wet; it flows and tastes salty. When King Wu of the Zhou Dynasty visited Qizi, a sage at that time, he learned about the five elements. People can survive even they do not eat food which they tastes either spicy, sour, sweet and bitter for as long as a year. However they cannot do without salt. If people do not eat salt for ten consecutive days, they will become so weak and tired that they can not even tie up a chicken. This proves that water is the creation of Nature, and the salt in water is the life-giving source for human beings. There exist large areas of bare and barren lands where crops and vegetables are not grown, but surprisingly, salt is produced and obtainable everywhere.

The Sources of Salt

The sources of salt vary greatly. Generally speaking, there are six sources—sea salt, lake salt, well salt, earth salt, rock salt and gravel salt. The “tree-leaf” salt in northeastern China and the “bright” salt consumed by ethnic minorities in northwestern China are not included. In China, sea salt accounts for eighty percent of all the salt produced, while well salt, lake salt and earth salt constitute the remaining twenty percent. Some of these salts are produced by using human labor while



【原文】

池、土碱。或假人力，或由天造。总之，一经舟车穷窘，则造物应付出焉。

海水盐

凡海水自具咸质。海滨地高者名潮墩，下者名草荡，地皆产盐。同一海卤传神，而取法则异。一法，高堰地，潮波不没者，地可种盐。种户各有区画经界，不相侵越。度诘朝无雨，则今日广布稻、麦稿灰及芦茅灰寸许于地上，压使平匀。明晨露气冲腾，则其下盐茅勃发。日中晴霁，灰、盐一并扫起淋煎。

一法，潮波浅被地，不用灰压。俟潮一过，明日天晴，半日晒出盐霜，疾趋扫起煎炼。一法，逼海潮入深地，先掘深坑，横架竹木，上铺席苇，又铺沙于苇席之上。俟潮灭顶冲过，卤气由沙渗下坑中，撤去沙苇，以灯烛之，卤气冲灯即灭，取卤水煎炼。总之功在晴霁，

【今译】

盐、土盐等占十分之二。这些盐或借人力制取，或由天然产出。总之，那些舟车不通、运不到盐的地方，大自然也会提供盐产的。

海水盐

海水本身便含盐质。海边地势高的地方叫潮墩，地势低的叫草荡，这些地方都产盐。虽然同样的盐出于海中，而制盐的方法却有不同。一种方法是，在不被海潮冲没的堤岸高地上种盐。种盐户各有划定的区域界限，互不侵越。预计次日无雨，则今天将稻、麦秆灰及芦茅灰广泛地撒在地上约一寸厚，压平使之均匀。至次日早晨露气冲腾之时，盐分便像茅草那样在灰层中长出。白天晴朗时，将灰和盐一起扫起并淋洗、煎炼。

另一种方法是，在浅滩地方不用草木灰压。只等潮水一过，至次日天晴，半天便能晒出盐霜，赶快去扫取煎炼。另一种方法是将海潮引至深处，先掘深坑，将竹或木横架在坑上，上铺席子，席上又铺沙。当海潮淹没坑顶而冲过之后，盐质便经过沙而渗入坑中。撤去沙、席，用灯放在坑内照之。盐卤气将灯火冲灭，这时便取卤



others are obtained in their natural state. In those areas where boats or carts can not reach to provide the people with salt, Nature will offer some kind of salt for the local people.

Sea Salt

Sea water contains salt. The high ground beside the sea is called a tidal mound and the low ground is called a marsh, and in both places salt is produced. There are different methods to obtain salt from the sea. One way is to extract salt on high ground which cannot be flooded by the tides. Each salt producer has his own assigned area which cannot be transgressed. When salt producers predict it will not rain the next day, they will spread ashes of rice, wheat and reed stalks about one *cun* thick over a wide area and press to make them smooth. When the dew begins to evaporate the next morning, salt will come out of the ashes, just like couch grass. When the sun comes out, the salt will be swept up together with the ashes to be leached and crystallized.

Another way of extracting salt is to obtain it on the low ground without using ashes. The low ground is first submerged by the tide. Wait until the tide recedes and the weather is sunny. Then a layer of salt frost will appear on the surface after the ground is exposed to the sun for half a day. The salt is swept up and refined immediately. People can also dig pits in the ground and lead the sea water into the pits. Some bamboo or wooden sticks are put across the opening of the pit; it is then covered with a reed mat, and sand is spread over the mat. When the tide comes in and covers the ground, the brine will drip through the sand into the pit. The mat and sand are then removed and a lamp is used to heat the brine in the pit. When the brine evaporates, the lamp goes out. The brine is then taken out and refined. The impor-



布灰种盐

Extracting salt by spreading ashes



淋水入坑

Sea brine passes through raw salt in a reed mat and drains into a shallow pit



【原文】

若淫雨连旬，则谓之盐荒。又淮场地面，有日晒自然生霜如马牙者，谓之大晒盐，不由煎炼，扫起即食。海水顺风漂来断草，勾取煎炼，名蓬盐。

凡淋煎法，掘坑二个，一浅一深。浅者尺许，以竹木架芦席于上。将扫来盐料（不论有灰无灰，淋法皆同），铺于席上。四周隆起，做一堤埧形，中以海水灌淋，渗下浅坑中。深者深七八尺，受浅坑所淋之汁，然后入锅煎炼。

凡煎盐锅，古谓之牢盆，亦有两种制度。其盆周阔数丈，径亦丈许。用铁者以铁打成叶片，铁钉拴合，其底平如盂，其四周高尺二寸。其合缝处一经卤汁结塞，永无隙漏。其下列灶燃薪，多者十二三眼，少者七八眼，共煎此盘。南海有编竹为者，将竹编成阔丈深

【今译】

水煎炼。总之，要靠天晴，如果阴雨连绵十日，则称为盐荒。另外，淮安、扬州产盐地面，有靠日晒自然生成像马牙那样的盐霜，谓之大晒盐，不用煎炼，从地上扫起即可食。顺风从海水中吹漂来的草类，勾取来煎炼，叫蓬盐。

淋洗、煎炼盐的方法是，掘两个坑，一浅一深。浅者深度为一尺左右，用竹或木将芦席架在坑上。将扫来的盐料（不论有灰无灰，淋法相同），铺在席上。席的四边围高些，做成堤坝形，中间部分用海水灌淋，渗入浅坑中。深的坑达七八尺深，接受浅坑所淋的卤水，然后入锅煎炼。

熬盐锅古时叫“牢盆”，也有两种形式。牢盆周围数丈，直径也有一丈左右。如用铁做成，则将铁打成薄片，再用铁钉拴合，其底平如盆，边高一尺二寸。接缝处一经卤水内盐分堵塞，便不再漏。锅下一排灶同时点火，多的有十二三眼灶，少的也有七八眼灶，共



tant factor for all these methods of extracting salt is fine weather, and if there is a prolonged spell of rain, a "salt famine" will result. In Huai'an and Yangzhou, salt frost shaped like horse teeth rise to the surface of the ground and crystallizes in the sun naturally. It is called "sun-dried salt". It does not need decocting and refining. After it is collected from the ground, it is ready to use. Some grass and straw come along with the sea water and sea wind and are drifted ashore. They can also be collected and boiled to obtain salt, which is called "straw salt".

The way to leach and decoct salt is to dig two pits side by side, a shallow one about one *chi* deep and a deep one about seven or eight *chi* deep which will receive the brine from the shallow pit. Cover the pits with a reed mat using the support of crossbars of bamboo or wood on the shallow pit. Spread the salt collected from the ground on the mat (the method of draining is the same whether or not ashes are mixed with the raw salt). The edges of the mat should be a little high and be shaped like a dam. Pour sea water into the center of the mat; the sea water will become brine and drain into the shallow pit. The brine then drains down into the deep pit. Finally, boil the brine in a pan for crystallization.

In ancient times there were two types of pans for crystallizing salt which are called *Strong Pans*. The Strong Pan has a circumference of several *zhang* and is about one *zhang* in diameter. The pan made of iron is constructed by striking iron into iron plates and the iron plates are put together by iron rivets. The bottom of the Strong Pan is level and the sides should be 1.2 *chi* high. The seams of the pan are filled with the salt from the brine and so they are watertight at all times. The furnace under the Strong Pan has as many as thirteen (at least seven to eight) doors at which fire is lighted at the same time to heat the pan.



【原文】

尺，糊以蜃灰，附于釜背。火燃釜底，滚沸延及成盐，亦名盐盆，然不若铁叶镶成之便也。凡煎卤未即凝结，将皂角椎碎和粟米糠二味，卤沸之时投入其中搅和，盐即顷刻结成。盖皂角结盐，犹石膏之结腐也。

凡盐淮、扬场者，质重而黑，其他质轻而白。以量较之，淮场者一升重十两，则广、浙、长芦者，只重六七两。凡蓬草盐不可常期，或数年一至，或一月数至。凡盐见水即化，见风即卤，见火愈坚。凡收藏不必用仓廩，盐性畏风不畏湿，地下叠稿三寸，任从卑湿无伤。周遭以土砖泥隙，上盖茅草尺许，百年如故也。

池 盐

凡池盐宇内有二：一出宁夏，供食边镇；一出山西解池，供晋、

【今译】

同烧火。南方沿海地区有用竹做成的，将竹编成阔一丈、深一尺的盆，糊上蜃灰，附于锅背。锅下烧火，卤水滚沸便逐渐成盐，也称为盐盆，但没有铁片镶成的牢盆便利。熬卤水未待其凝结时，将皂角捣碎，混合粟米糠，卤水沸时投入其中搅和，食盐便顷刻结成。用皂角结盐，就像用石膏点豆腐一样。

淮安、扬州盐场的盐，质重而黑，别处的盐质轻而白。如以重量来对比，淮安盐场的盐一升重十两，而广东、浙江、长芦盐场的盐只重六七两。不能总期待有蓬草盐，或数年来一次，或一月来数次。盐见水即化，见风即卤，见火愈坚。收藏盐不必用仓库，盐性怕风不怕湿。地上铺稻草三寸，即令在低湿之处亦无妨。如四周砌土砖以泥塞缝，上盖一尺厚的茅草，则保存一百年也不会变质。

池 盐

池盐国内有两个产地：一处是在宁夏，供边镇食用；另一处是在山西



In the coastal areas in the south some pans are made of bamboo. The bamboo is woven into pans one *zhang* in width and one *chi* in depth. The bamboo pan is plastered with clamshell lime and is attached to the inside of a large iron pot. When fire is lighted under the pot, heat is transmitted to the bamboo pan, and the brine boils, subsequently crystallizing into salt. These salt pans are not practical as the iron ones. If the boiled brine is slow to crystallize, a mixture of the ground pods of Zaojiao (*Gleditsia sinensis*), millet grains and chaff should be added to the boiling liquid, and salt can be obtained shortly afterwards. The role of the gleditsia pods in the crystallization of salt is similar to that of plaster-of-Paris in the solidification of bean curds.

The salt produced in Huai'an and Yangzhou is heavy and black, while the salt produced in other places is light and white. Considering the weight, the Huai'an salt weighs ten *liang* per *sheng*, while the salt produced in Guangdong, Zhejiang and Changlu weighs six or seven *liang* per *sheng*. There is not always straw salt. It may be collected several times a month or only once in several years. Salt dissolves whenever it meets water, become brine whenever it meets wind, and turn stronger when meeting fire. It is not necessary to store salt in a warehouse, as salt can stand moisture, but not wind. Spread a layer of straw about three *cun* thick on the ground. It doesn't matter whether the ground is low and wet. If people lay adobes around and fill the gaps with loess, and cover it with one *chi* of couch grass, the salt will stay intact and fine even for one hundred years.

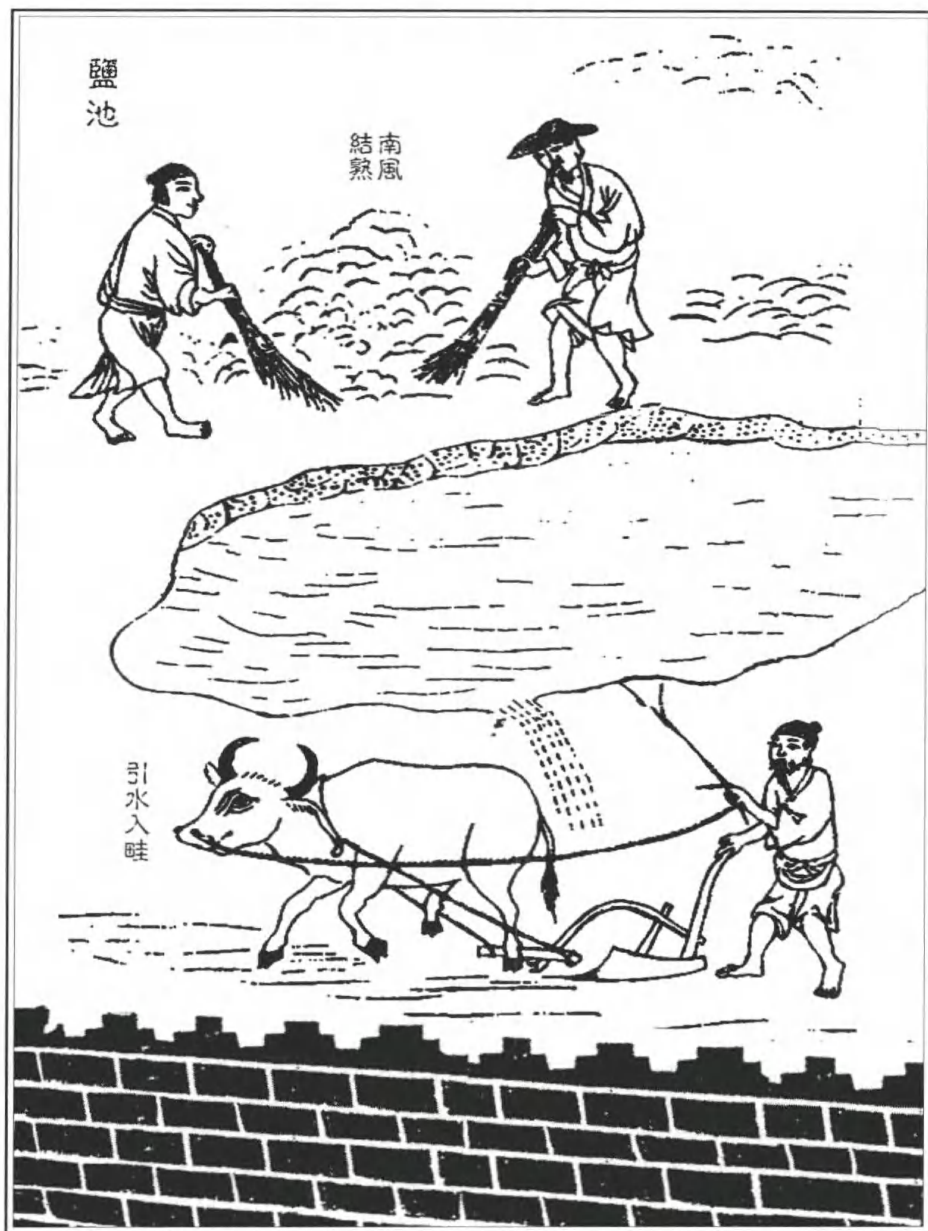
Lake Salt

Lake salt is produced in two places in China: one is in Ningxia, whose salt is supplied to the frontier towns and the other is in Xie Lake



煎煉海鹵

Boiling salt brine by using the strong pan



池盐

Introducing lake brine into plots (lower); collecting sun-dried salt (upper)



【原文】

豫诸郡县。解池界安邑、猗氏、临晋之间，其池外有城堞，周遭禁御。池水深聚处，其色绿沉。土人种盐者，池旁耕地为畦垄，引清水入所耕畦中，忌浊水，渗入即淤淀盐脉。

凡引水种盐，春间即为之，久则水成赤色。待夏秋之交，南风大起，则一宵结成，名曰颗盐，即古志所谓大盐也。凡海水煎者细碎，而此成粒颗，故得大名。其盐凝结之后，扫起即成食味。种盐之人积扫一石交官，得钱数十文而已。其海丰、深州引海水入池晒成者，凝结之时，扫食不加人力，与解盐同。但成盐时日与不借南风，则大异也。

井 盐

凡滇、蜀两省远离海滨，舟车艰通，形势高上，其咸脉即蕴藏地

【今译】

解池，供应山西、河南诸郡县。解池位于安邑、猗氏、临晋之间，池外有城墙，周围被护卫。池水深处，其色暗绿。当地制盐者在池旁将地犁成畦垄，将池内清水引入所犁的畦中，切忌浊水混入，否则就会淤塞盐脉。

引池水种盐在春季进行，迟则水成红色。待夏秋之交，南风大起，则一夜之间即结成盐，名曰颗盐，即古书所谓大盐。因为从海水熬出的盐细碎，而池盐颗粒较大，故名大盐。此盐凝结之后，扫起即可食用。种盐的人要将积扫的一石盐交官府，自己只得几十个铜钱而已。海丰、深州引海水入池晒成的盐，不用煎炼，凝结之时，扫取即食，与解盐同。但成盐时间不靠南风，则与解盐大不相同。

井 盐

云南、四川远离海滨，舟车难通，地势较高，故其盐脉即蕴藏于



in Shanxi Province, which provides salt to the counties and towns in Shanxi and Henan provinces. Xie Lake is located in the intersection of Anyi, Dishu and Linjin. Xie Lake is surrounded by a rampart for protection. The deep lake water is dark green. Native salt producers plough the field beside the lake into ridges and lead the clean water into the pool to the ridges. They take care not to let in turbid water; otherwise, the turbid water will silt up the ridges.

People plough the land near the lake into plots separated by dykes, and introduce clear brine from the lake into the plots. The extracting of salt is done in spring. If it is done later than the required time, the brine will turn red. Toward late summer or early autumn when the south wind blows hard across this area, the brine evaporates entirely and salt crystallizes overnight, which is called “grain salt”, also termed “large salt” in ancient books, because this lake salt is formed in big crystals, hence the term “large” while sea salt is finely granulated. Lake salt can be used as table salt soon after it crystallizes and is gathered. Salt producers have to turn in one *dan* of salt to the authorities and receive only a few dozen copper cash. In Haifeng (the present Yanshan, or “Salt Mountain”, County in Hebei) and Shenzhou (the present Shen County in Hebei), where sea water is introduced into ponds on the shore and crystallized by the sun, salt can also be used directly as table salt without refining, which is the same as Xie Lake salt. It differs greatly from the latter, because the crystallization of salt in these places does not depend on the south wind.

Well salt

Yunnan and Sichuan provinces are remote from the sea. Moreover, these places are geographically at a high altitude. So boats and carts



【原文】

中。凡蜀中石山去河不远者，多可造井取盐。盐井周围不过数寸，其上口一小孟覆之有余，深必十丈以外乃得卤信，故造井功费甚难。其器冶铁锥，如碓嘴形，其尖使极刚利，向石山春凿成孔。其身破竹缠绳，夹悬此锥。每春深入数尺，则又以竹接其身，使引而长。初入丈许，或以足踏碓梢，如舂米形。太深则用手捧持顿下。所舂石成碎粉，随以长竹接引，悬铁盞挖之而上。大抵深者半载，浅者月余，乃得一井成就。

盖井中空阔，则卤气游散，不克结盐故也。井及泉后，择美竹长丈者，凿净其中节，留底不去。其喉下安消息，吸水入筒，用长縲系竹沉下，其中水满。井上悬桔槔、辘轳诸具，制盘驾牛。牛拽盘

【今译】

地中。四川境内离河不远的石山，多可凿井取盐。盐井口径不过数寸，其上口盖一个小盆尚且有余，但深度必在十丈以上，才能得到卤信（盐层），故凿井特别费工夫。凿井器具用碓嘴形的铁锥，要使其尖部极其刚利，足以能将石层冲凿成孔。夹悬此锥的锥身（锥柄）用破成两半的竹做成，以绳缠紧。每钻深进数尺，则以竹将其接长。最初凿入一丈深，可用脚踏碓梢，就像舂米那样。太深时则用手持锥向下冲凿。所舂的岩石已成碎粉，随时接引长竹悬铁夹将碎石挖取上来。大抵深井要半年，浅井要一月多才能凿成一口。

井口宽阔会使盐卤流散，不能结盐。盐井凿到盐卤泉水时，选用一丈长的好竹，将竹筒内中节凿穿，保留最下一节不去掉。在节端安上消息以便吸盐水入筒，用长的粗绳索将竹筒系住沉入井下，筒内水

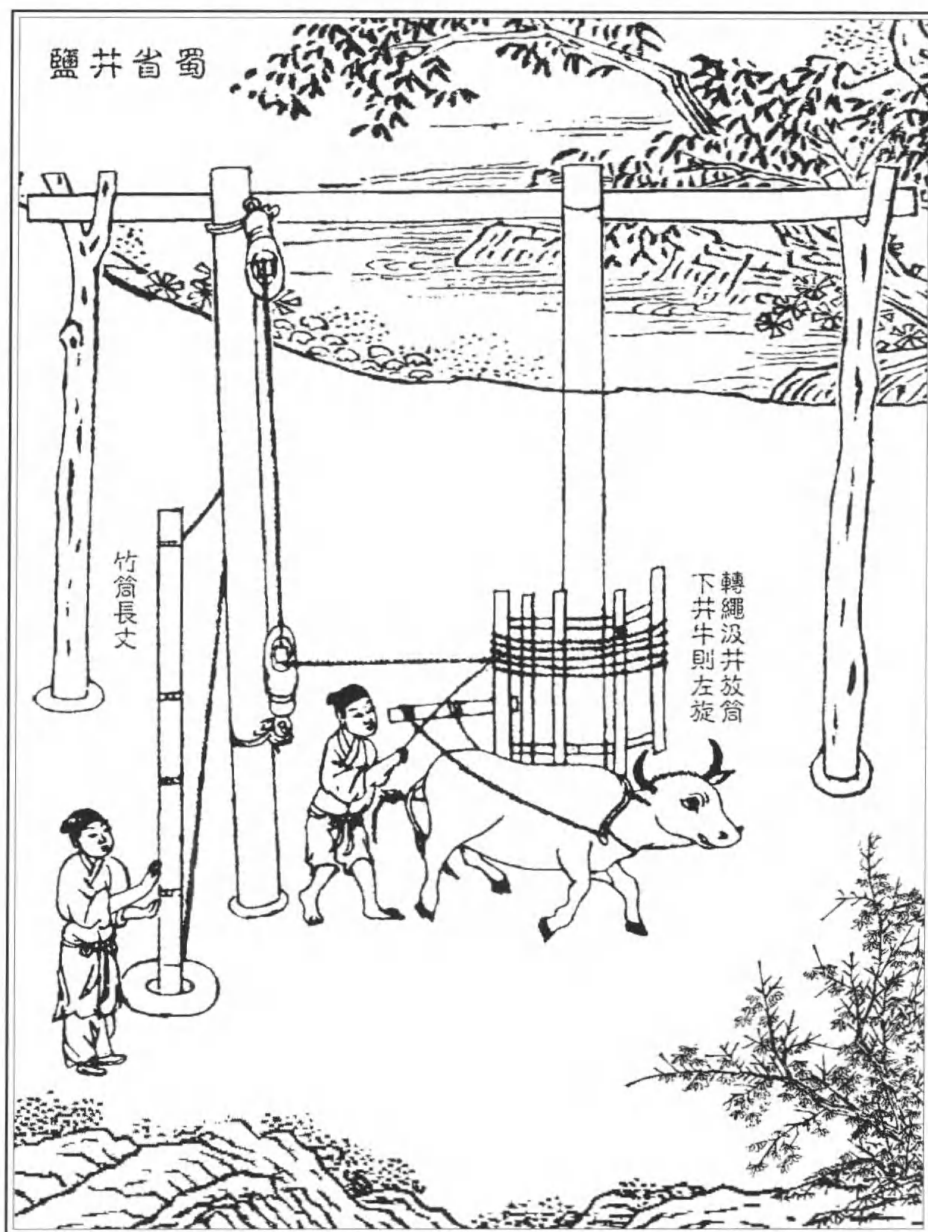


can not reach there easily. Their source of salt is buried deep underground. There are rocky mountains in Sichuan which are not far from rivers; people dig wells and get salt from them. The shaft of the well is no more than several *cun* in diameter. It is so small that a small-sized basin can cover it. But the well has to be drilled over ten *zhang* deep to get to the salt bed. Therefore, it takes great effort to dig such wells. The tool used to drill holes in the mountain rocks is an iron drill with a very hard and sharp tip which is shaped like the blade of a chisel. The drill is suspended and held in place by a bundle of split bamboo strips and fastened together with ropes. Each time the rock has been drilled a few *chi* deeper, the bamboo-suspender is lengthened by fixing another section of bamboo to it. When the salt well is drilled one *zhang* or so, the drilling device is operated by stepping on it with one's feet, in the same way of pounding rice in a mortar. When the salt well is drilled still deeper, the drilling device is operated by hand. The fragments of rock that result from the drilling are scooped up with an iron vessel attached to a long bamboo pole. It takes more than a month to dig a shallow well, and half a year to dig a deep well.

The reason why the shaft of the salt well is made small is that a wide shaft allows the brine to degrade, through dissipation of its vapor, and become unsuitable for making salt. When the brine level in the well is reached, good bamboo stalks about one *zhang* long are chosen, and all the inner section partitions, except the one in the bottom end, are removed from them and a valve which allows the brine to enter is set in that partition. This bamboo is lowered into the well with a long rope. After it fills with brine, it is lifted to the surface by means of a pulley fixed over the well and a windlass turned by an ox-powered wheel. The brine thus obtained is then poured into a pan for evapora-



四川井盐
Drilling a salt well in Sichuan



四川井盐
Drilling a salt well in Sichuan



【原文】

转，辘轳绞绳，汲水而上。入于釜中煎炼（只用中釜，不用牢盆），顷刻结盐，色成至白。

西川有火井，事奇甚。其井居然冷水，绝无火气。但以长竹剖开去节，合缝漆布，一头插入井底。其上曲接，以口紧对釜脐，注卤水釜中，只见火意烘烘，水即滚沸。启竹而视之，绝无半点焦炎意。未见火形而用火神，此世间大奇事也。凡川、滇盐井逃课掩盖至易，不可穷诘。

末盐、崖盐

凡地碱煎盐，除并州末盐外，长芦分司地土人亦有刮削煎成者，带杂黑色，味不甚佳。凡西省阶、凤等州邑，海、井交穷。其岩穴自生盐，色如红土，恣人刮取，不假煎炼。

【今译】

满。井上悬桔槔、辘轳等工具，架起转盘并套上牛。牛拉盘转，辘轳绞绳，吸水而上。将卤水放入锅中煎炼（只用中号锅，不用大号的牢盆），则很快就结盐，颜色很白。

四川有火井，很奇妙。井内居然全是冷水，并没有火。但以长竹筒剖开去掉中节，借漆与布将合缝封闭，一头插入井底。另一头接以曲管，其口紧对锅底正中，将卤水注入锅中，只见火焰烘烘，卤水即刻滚沸。打开竹筒而视之，绝无半点烧焦的痕迹。火井中的气没有火的形状，但引燃后却有火的功用，这是世间的一大奇事。四川、云南的盐井，逃税很容易，没办法追究。

末盐、崖盐

由地碱熬出的盐，除山西并州的末盐（土盐）以外，长芦盐场盐运使分司管辖的地区内，也有人刮土熬成盐的，这种盐有杂质，而且色黑，味不甚美。西部阶州、凤州等地，既没有海盐，也没有井盐。但当地岩穴中却自成岩盐，色如红土，任人刮取，不必熬炼。



tion and crystallization (only a medium-sized pan, rather than a Strong Pan, is used). Salt with a very white color is obtained from the crystallization process.

It's highly amazing that there are "fire" wells in Sichuan. However, there is actually no "fire" in the salt wells, just cold water. In fact, these "fire" wells are indeed wells which contain natural gas. Split open a long bamboo stalk and take out the inner partitions; then put the stalk together again and securely wrap it with varnished cloth. Then put one end of this bamboo stalk into the well, while the exposed end is connected to a curved section of bamboo in order to reach the bottom of the salt pan which is now filled with brine. It will be seen the heat radiating from the mouth of the bamboo boils the brine in the pan. Yet if the bamboo stalk is opened and examined, no evidence of charring or burning can be seen. The natural gas contained in the fire well does not take the shape of fire but once it is lighted, it functions like fire. It is indeed one of the strangest things in the world! As a result, it is very easy for the operators of the salt wells in Sichuan and Yunnan provinces to avoid paying the salt taxes by covering up the wells. It is impossible to track down all these people.

Earth Salt and Rock Salt

Salt can also be obtained from alkaline soils. Besides the earth salt in Bingzhou in Shanxi Province, some people make salt from the earth. Some officials in Changlu are in charge of this. There is impurity in this kind of salt, so it is a little black and not tasty. There is no sea salt or well salt in Jiezhou and Fengzhou in Shanxi Province. However, there is salt formed naturally in the grotto which has the same color as red earth. People can peel it down and eat it without any refining.



甘嗜第四

【原文】

宋子曰，气至于芳，色至于艳，味至于甘，人之大欲存焉。芳而烈，艳而艳，甘而甜，则造物有尤异之思矣。世间作甘之味，十八产于草木，而飞虫竭力争衡，采取百花酿成佳味，使草木无全功。孰主张是，而颐养遍于天下哉？

蔗 种

凡甘蔗有二种，产繁闽、广间，他方合并得其十一而已。似竹而大者为果蔗，截断生啖，取汁适口，不可以造糖。似荻而小者为糖蔗，口啖即棘伤唇舌，人不敢食，白霜、红砂皆从此出。凡蔗古来中国不知造糖，唐大历间西僧邹和尚游蜀中遂宁始传其法。今蜀中

【今译】

宋子说，芬芳的香气、鲜艳的颜色、香甜的滋味，都是人们所欲望的。有些天然产物香气甚为强烈，有些颜色鲜艳，另有些则味道甜美，这都是大自然的特别的安排。世间产生甜味之物，十分之八来自甘蔗，但蜜蜂也竭力争衡，采集百花而酿成蜂蜜，使甘蔗不能独占全功。是哪种自然力的作用使甘蔗和蜜蜂产生甜味而滋养天下人呢？

蔗 种

甘蔗有两种，盛产于福建、广东一带，其余地方产蔗加起来也只有这两地的十分之一。甘蔗中像竹但比竹大的，是果蔗，切断后生吃，汁液可口，但不能制糖。像是荻但比荻小的是糖蔗，口嚼则棘伤唇舌，人不敢生吃，白糖、红砂糖都是由糖蔗生产的。古代中国不知用蔗造糖，唐代大历年间佛僧邹和尚游经四川遂宁，始传制



Chapter 4

Sugar Making

Songzi says that all human beings appreciate fragrance, bright colors, and sweet flavor. Some natural products have a strong fragrance, some are brightly colored, and others taste sweet. These are all creations of nature. Most of the sweet things in the world come from sugar cane, while bees are doing their utmost to gather all sorts of flowers to make honey, thus making sugar cane unable to monopolize the whole contribution of making sugar. What kind of natural force makes sugar canes and honey taste sweet to nourish human beings all over the world after all?

Types of Sugar Canes

There are two types of sugar canes, abounding in Fujian province and Guangdong provinces. The output of all the other provinces altogether contributes only 10 percent of the output of the above two provinces. The “fruit” sugar cane, which looks like bamboo but is bigger than bamboo, can be cut off and eaten raw. However, it cannot be used to refine sugar. Sugar cane, which looks like reed but is smaller, is too thorny to be eaten raw by man, because it cuts one’s lips and tongue. White sugar and brown granulated sugar are made from sugar cane. In ancient China people knew nothing about using sugar cane to make sugar. During the Dali reign of the Tang Dynasty, the Buddhist monk Zou visited Suining in Sichuan Province, and since then the method of making sugar has been handed down year after year. Now it



【原文】

种盛，亦自西域渐来也。

凡种获蔗，冬初霜将至，将蔗砍伐，去杪与根，埋藏土内（土忌洼聚水湿处）。雨水前五六日，天色晴明即开出，去外壳，砍断约五六寸长，以两节为率。密布地上，微以土掩之，头尾相枕，若鱼鳞然。两芽平放，不得一上一下，致芽向土难发。芽长一二寸，频以清粪水浇之。俟长六七寸，锄起分栽。

凡栽蔗必用夹沙土，河滨洲土为第一。试验土色，掘坑尺五许，将沙土入口尝味，味苦者不可栽蔗。凡洲土近深山上流河滨者，即土味甘亦不可种。盖山气凝寒，则他日糖味亦焦苦。去山四五十里，平阳洲土择佳而为之（黄泥脚地，毫不可为）。

凡栽蔗治畦，行阔四尺，犁沟深四寸。蔗栽沟内，约七尺列三

【今译】

糖之法。现在四川种植很多甘蔗，也是从西域逐渐传来的。

种植获蔗都是在冬初快降霜时，将蔗砍下，去除其梢及根后埋在土内（不要埋在低洼积水的土内）。雨水节气前五六日天气晴朗时，将蔗取出并去其外壳，砍断约五六寸长，每段要有两个节，密排在地上，用少许土盖上，使头尾相叠，像鱼鳞似的。每段蔗上的两个芽要平放，不得一上一下，致使向下的芽难以萌发。芽长到一二寸时，经常以清粪水浇，待长到六七寸时，便挖出来分栽。

栽蔗必须用夹沙土，靠近江河边的土地最好。试验土质时，掘一尺五寸左右的坑，将其中沙土入口中尝味，味苦者不可栽蔗。但靠近深山河流上游的河边土，即使土甜也不可栽种蔗。这是因为山地气候寒冷，他日用蔗制成的糖也会味苦。在离山四五十里的平坦、向阳的河边土地，选择最好的地段进行种植（黄泥土不适于种植）。

栽蔗时要整地作畦，每行宽四尺，犁四寸深的沟。将蔗栽在沟



is said that much of the sugar cane which is planted in Sichuan Province originally grew in the Western Regions ["areas west of Yumenquan Pass", including present Xingjiang and parts of Central Asia] and introduced to the Central Plains.

The best time to plant sugar canes is the early winter before the coming of frost. The sugar canes are uprooted and buried by earth (avoid low ground or places where water gathers) after removing the tops and roots. Five or six days before the solar term of Rain Water in the following spring, the sugar canes are dug out of the earth on sunny days. After the bark is peeled off, the canes are cut into sections five or six *cun* long leaving two joints to a section. Then all the sections will be laid on the ground next to each other and then covered with earth. The ends of the sections overlap like fish scales. The two buds on each section of the sugar cane should be put in a level position since it is difficult for them to sprout when the buds are covered by each other. When the buds grow to one or two *cun* high, they should be watered with liquid manure frequently. When the young plants are six or seven *cun* high, it is time to transplant them.

The sandy soil is best for planting sugar cane, especially the alluvial soil along rivers. To test whether the soil is right for the sugar cane, the earth is dug one *chi* and five *cun* deep and a sample of this sandy soil is tasted in the mouth. If it tastes bitter no sugar cane should be planted in it. However, sugar cane should not be planted along the upper reaches of streams close to remote mountains either, even though the soil there is sweet because the cold climate in the mountain region will give the sugar cane a bitter taste later on. The flat land near the river facing the sun, which is about forty or fifty *li* away from the mountains, is the best location for planting sugar cane (but sugar canes are not planted in yellow earth).



【原文】

丛，掩土寸许，土太厚则芽发稀少也。芽发三四个或五六个时，渐渐下土，遇锄耨时加之。加土渐厚，则身長根深，蔗免欹倒之患。凡锄耨不厌勤过，浇粪多少视土地肥饶。长至一二尺，则将胡麻或芸苔枯饼浸和水灌，灌肥欲施行内。高二三尺，则用牛进行内耕之。半月一耕，用犁一次垦土断旁根，一次掩土培根。九月初培土护根，以防斫后霜雪。

蔗 品

凡获蔗造糖，有凝冰、白霜、红砂三品。糖品之分，分于蔗浆之老嫩。凡蔗性至秋渐转红黑色，冬至以后由红转褐，以成至白。五岭以南无霜国土，蓄蔗不伐，以取糖霜。若韶、雄以北，十月霜侵，蔗质遇霜即杀，其身不能久待以成白色，故速伐以取红糖也。凡取

【今译】

内，大约七尺栽三棵，盖上一寸厚的土，土太厚时发芽便少。每棵长出三四个或五六个芽时，逐渐培土，每逢中耕除草时都要培土。培土逐渐加厚，则蔗秆高而根深，可避免倒伏之患。中耕除草不厌其勤，浇粪多少视土地肥瘠而定。待长至一二尺高时，则将芝麻枯饼或油菜子枯饼泡水浇肥，肥料要施在行内。蔗高至二三尺时，用牛在蔗田行内耕作。每半月犁一次，一次用来翻土并犁断旁根，一次用来掩土培根。九月初则培土护根，以防砍后蔗根被霜雪冻坏。

蔗糖种类

获蔗造出的糖有凝冰糖、白霜糖、红砂糖三种。糖的品种由蔗浆的老嫩来决定。获蔗外皮到秋天逐渐变成深红色，冬至后由红色转褐色，最后成为白色。五岭以南无霜地区，获蔗放在田里不砍，用以造白糖。但广东韶关、南雄以北，十月即降霜，蔗质遇霜即遭破坏，不能在田里久放以成白色，故速伐以取红糖。造红糖要尽力



The land for planting sugar cane should be prepared by ploughing it into four-*chi*-wide ridges with four-*cun*-deep ditches. Put three pieces of sugar cane in every seven-*chi*-long ditch and cover them with one-*cun* of soil. It is difficult for the sugar cane to sprout when the soil is too thick. When four or five buds appear on a piece of sugar cane, it should be earthed up gradually. Every time when ploughing and weeding the ground, earth it up and thicken it gradually too, then the sugar cane stalk will grow high with deep roots without dislodging. It will be better to do the ploughing and weeding frequently; the amount of manure needed depends mainly on the fertility of the soil. When the sugar cane is one or two *chi* high, water-soaked withered cakes of sesame or rapeseeds can be used as manure and watered into the sugar cane within the ditches. When the sugar cane is about two or three *chi* high, the ox can be used to cultivate the fields. Plough two times a month: one time for turning up the soil and cutting off the side roots, while the other time for banking up the soil and protecting the roots. Bank and protect the roots at the beginning of September so that the roots will not be damaged by frost and snow.

Types of Cane Sugar

The types of sugar refined out of reed sugar cane include rock sugar, white sugar, and brown sugar. The variety of sugar is determined by the age of sugar cane juice. The rind of the sugar cane will gradually become dark red in autumn and then turn brown after the Winter Solstice and finally it will turn white. In the frostless area in the south of Wuling Mountains, sugar cane can be kept in the field for making white sugar. But in the north of Nanxiong in Shaoguan, Guangdong Province, the frost occurs promptly in October and consequently the



【原文】

红糖，穷十日之力而为之。十日以前，其浆尚未满足。十日以后遇霜气逼侵，前功尽弃。故种蔗十亩之家，限制车、釜一副，以供急用。若广南无霜，迟早惟人也。

造 糖

凡造糖车，制用横板二片，长五尺，厚五寸，阔二尺，两头凿眼安柱。上樨出板少许，下樨出板二三尺，埋筑土内，使安稳不摇。上板中凿二眼，并列巨轴两根（木用至坚重者），轴木大七尺围方妙。两轴一长三尺，一长四尺五寸，其长者出樨安犁担。担用屈木，长一丈五尺，以便驾牛团转走。轴上凿齿，分配雌雄，其合缝处须直而圆，圆而缝合。夹蔗于中，一轧而过，与棉花赶车同义。

【今译】

在霜降前十天内完成。再早则蔗浆还没生得充足，再晚则又怕霜冻侵袭而前功尽弃。故种十亩蔗的人家应制一套造糖用的糖车和锅以供急用。像广东南部无霜地区，则砍蔗早晚由人决定。

造 糖

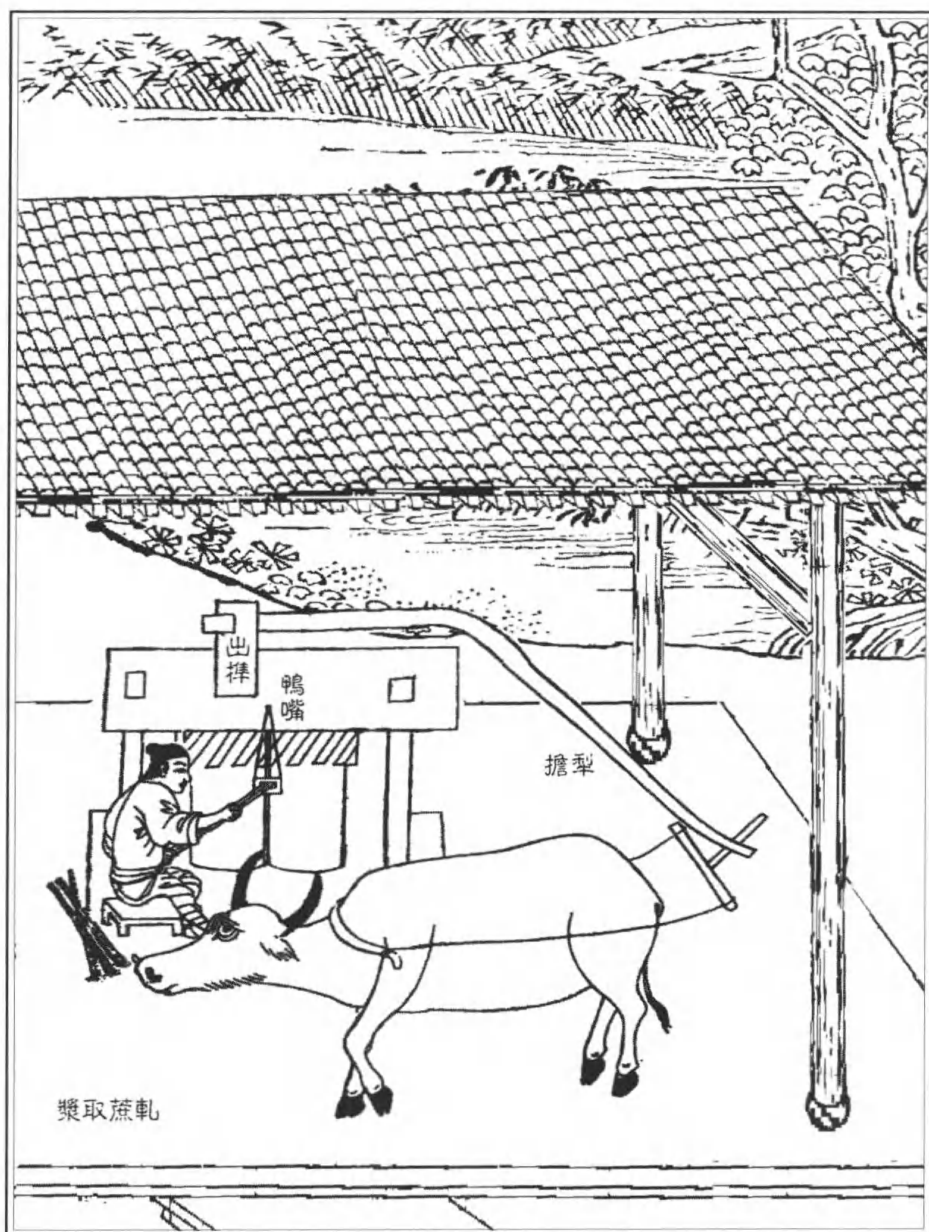
制造糖车要用两块横板，各长五尺，厚五寸，宽二尺，板的两端凿孔安柱。柱上部的樨露出横板外一些，下樨穿过下横板外露二三尺，埋在地下，使糖车安稳不摇动。上横板中部凿二眼，并列安上两根大木辊（用极硬而重的木料），木辊周长大于七尺的才适合。两辊中一个长三尺，另一个长四尺五寸。长辊的樨露出横板以便安装犁担。犁担用长一丈五尺的曲木做成，以便驾牛转圈走动。辊上凿有互相咬合的凹凸齿，两辊相遇之处必须直而圆，使之密合。把蔗夹在两辊之间一轧而过，这与轧棉花的赶车是同样的道理。



sugar cane will be destroyed. Therefore, there is no time for the sugar cane to become white in the field and it should be cut down ten days before the frost occurs in order to make brown sugar. If it is cut down earlier than that, there will be not enough juice; if it is cut down later than that, it is possible that the frost will nullify all the previous efforts. Therefore, the farmers, who plant ten *mu* of sugar cane, should prepare a cart for making sugar and a pan for urgent use. In the frost-free area of southern Guangdong, the time to cut down sugar cane is completely up to the farmers.

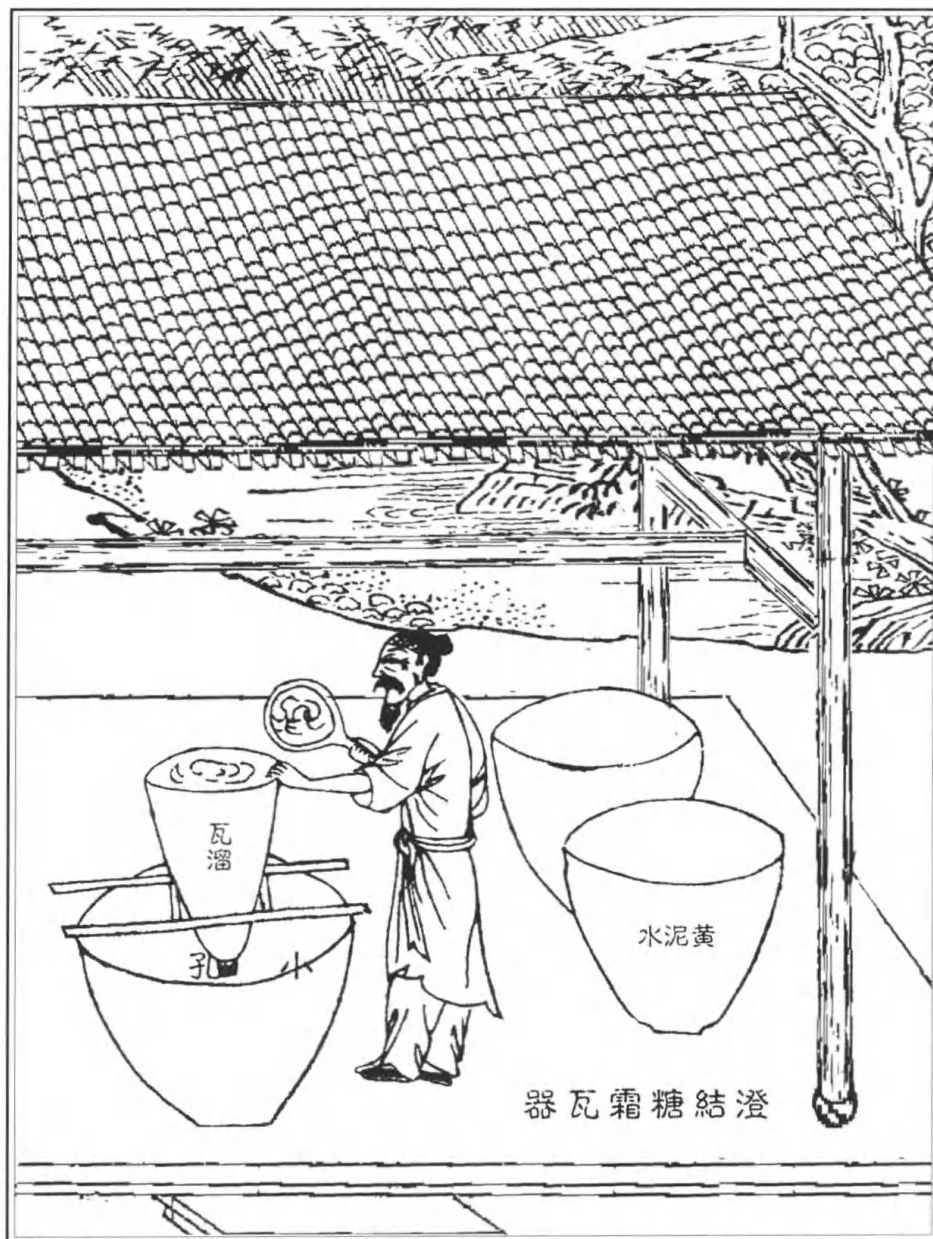
Making Brown Sugar

The vertical roll crusher in sugar manufacturing used for crushing cane is constructed as follows: take two wooden boards measuring five *chi* long, two *chi* wide, and five *cun* thick. Drill holes at the end of each board to accommodate the supporting posts. The upper ends should extend two or three *chi* below the lower board and be buried in the ground, so that the whole apparatus will be stable. At the center of the upper board two openings should be made (through which two large rollers made of very hard wood are placed next to each other). It would be best to have the rollers measuring seven *chi* in circumference. One of the rollers should be three *chi* long, the other four and a half *cun* in length. Affixed to the protruding end of the latter one is a curved pole measuring one *zhang* and five *chi* in length that has been made of bent wood. This is attached to an ox that pulls it in a circle and thus turns the crusher. The surfaces of both rollers are deeply corrugated or cogged; the cogs of one roll fit into the grooves between cogs of the other. The sugar cane which passes between the two toothed rollers is pressed and crushed. This has the same principle as the cotton gin.



造红糖

Crushing cane with a vertical-toothed roll crusher



造白糖

Making white sugar



【原文】

蔗过浆流，再拾其滓，向轴上鸭嘴吸入，再轧而三轧之，其汁尽矣，其滓为薪。其下板承轴，凿眼只深一寸五分，使轴脚不穿透，以便板上受汁也。其轴脚嵌安铁锭于中，以便掇转。凡汁浆流板有槽视，汁入于缸内。每汁一石下石灰五合于中。凡取汁煎糖，并列三锅如“品”字，先将稠汁聚入一锅，然后逐加稀汁两锅之内。若火力少束薪，其糖即成顽糖，起沫不中用。

造 白 糖

凡闽、广南方经冬老蔗，用车同前法。榨汁入缸，看水花为火色。其花煎至细嫩，如煮羹沸，以手捻试，黏手则信来矣。此时尚黄黑色，将桶盛贮，凝成黑沙。然后以瓦溜（教陶家烧造）置缸上。其溜上宽下尖，底有一小孔，将草塞住，倾桶中黑沙于内。待黑沙

【今译】

蔗经木辊压榨后便流出蔗浆，再拾起榨过的蔗插入辊上的鸭嘴中再三榨之，蔗汁便榨尽，剩下的蔗渣可当柴烧。支承双辊的下面横板上凿两个深一寸五分的眼，使辊轴不穿过下横板，以便在板上接受蔗汁。辊轴下端要镶铁以便于转动。接收蔗汁的下横板上有槽，蔗汁通过槽流入缸内。每一石蔗汁要加入五合石灰在其中。取汁熬糖时，将三口铁锅排成“品”字形，先将熬浓的蔗汁集中在一口锅内，再逐步将稀汁加入另外两锅内。如火力不足，即令少一把柴，也会把糖汁熬成顽糖，只起泡沫而不中用。

造 白 糖

福建、广南地区整个冬天放在田里的老蔗，用糖车压榨与前述方法相同。榨出的蔗汁流入缸中，熬糖时观察糖汁沸腾时的水花来掌握火候。当熬到水花呈小泡像煮沸的肉羹那样时，用手捻试，如果黏手就说明火候到了。此时仍是黄黑色，用桶盛贮，凝成黑沙。然后将瓦溜（请陶工烧造）放在缸上。瓦溜上宽下尖，底部有一小孔，



Juice will flow out when the sugar cane is pressed by the wooden roller. Then the pressed sugar cane will be inserted into the duckbill on the roller and again and again to make sure all the juice has been taken out of it. The residue can be used as firewood. Dig two holes of one *cun* and 5 *fen* deep on the horizontal plank which supports the pair of rollers to prevent the axle from cutting through the plank. Then the sugar cane juice will remain on the plank. In order for the roller to rotate it more smoothly, some iron pellet is affixed to the bottom of the axle. There are slots on the horizontal plank through which the sugar cane juice can flow into the jar. Every *dan* of sugar cane juice should be mixed with half a *sheng* of lime to coagulate undesirable impurities. In boiling the juice for sugar, put three cooking pots to form a triangle and use them simultaneously. Gather the thick syrup which has been obtained after boiling the thin juice in the three pots and transfer it into one pot. Then pour more thin juice into the other two pots. If the heat is insufficient, even a lack of a handful of firewood, the juice will become irregular; it will be full of foam and useless.

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Making White Sugar

The old sugar canes kept in the field throughout the winter in the south of Fujian and Guangdong provinces are pressed in roll crushers to get juice in the same way as mentioned above. The heat control for refining the juice of sugar cane can be adjusted by watching the bubbles when it is boiled. When small bubbles like the bubbles of boiled meat broth appear and the juice sticks to hands while rubbing them, the boiling is sufficient. The color of the boiled syrup is dark yellowish. Next put the syrup in a barrel and it will crystallize into dark granules. Set an earthenware funnel (made of pottery) on the jar. The top of the



【原文】

结定，然后去孔中塞草，用黄泥水淋下。其中黑滓入缸内，溜内尽成白霜。最上一层厚五寸许，洁白异常，名曰西洋糖（西洋糖绝白美，故名）。下者稍黄褐。

造冰糖者，将洋糖煎化，蛋青澄去浮滓，候视火色。将新青竹破成篾片，寸斩撒入其中。经过一宵，即成天然冰块。造狮、象、人物等，质料精粗由人。凡冰糖有五品，石山为上，团枝次之，瓮鉴次之，小颗又次，沙脚为下。

造 兽 糖

凡造兽糖者，每巨釜一口受糖五十斤，其下发火慢煎。火从一角烧灼，则糖头滚旋而起。若釜心发火，则尽尽沸溢于地。每釜用鸡子三个，去黄取青，入冷水五升化解。逐匙滴下，用火糖头之上，则浮沤、黑滓尽起水面，以笊篱捞去，其糖清白之甚。然后打入铜铤，下

【今译】

用草将孔塞住，把桶内的黑沙倒入瓦溜内。待黑沙凝固，然后除去孔中塞草，用黄泥水从上淋下。其中黑滓淋入缸内。瓦溜内则尽成白糖。最上一层厚五寸许，洁白异常，叫西洋糖（因为西洋糖特别白，故得此名）。下面的稍带黄褐色。

制造冰糖时，将白砂糖熬化，用鸡蛋清澄去浮滓，看火候是否合适。将新竹破成一寸长的篾片撒入糖汁中，经过一夜便成为像天然冰块那样的冰糖。做成狮子、象和人物等形状的糖，质料粗细可随人决定。冰糖有五个品种，“石山”是上等品，“团枝”次之，“瓮鉴”次之，“小颗”又次之，而“沙脚”是下等品。

造 兽 糖

造兽形糖时，在每口大锅里放糖五十斤，锅下点火慢熬。火从锅的一角烧热，则熔化的糖液便滚旋而起。如果火在锅心燃起，则糖液便全面沸腾而溅溢到地上。每锅用鸡蛋三个，去黄取青，入冷水五升化开。将蛋白水一勺一勺地浇在糖液滚沸之处，泡沫和黑滓便浮在水面上，用笊篱捞去，这时糖液就特别清白。然后将糖液放入有柄及出



funnel is wide while the bottom is narrow; there is a small hole at the bottom, which is clogged with straw. Pour the dark granules into the funnel. When it is congealed, remove the straw in the hole and pour yellow-earth water into the funnel. The black residue is drenched into the jar so the white sugar is left in the funnel. The top layer of it is five *cun* thick and purely white, which is called “Western sugar” (because Western sugar is very white). At the bottom part, the sugar is somewhat yellow-brown in color.

To make rock sugar, dissolve the white sugar in water and distill the dross with egg white. The heating must be sufficient. Split new bamboo into thin strips of one *cun* long and put them into the syrup of the white sugar. Overnight they will become rock sugar, like natural ice-cubes. Rock sugar can be made into different shapes such as lions, elephants and dolls. The quality of the rock sugar varies. There are five grades of white sugar including “Rock Mountain”, which is of the top grade, followed by clustered branch, “glossy jar”, “small grain” and “sandy bottom”, the lowest grade.

Making Animal-Shaped Candies

To make animal-shaped candies, put fifty *jin* of sugar in a large pot and light a fire under the pot to boil the sugar slowly and gradually. When the heating starts from one side of the pot, the sugar syrup will boil gently. But if the heating starts directly under the pot, the sugar syrup will seethe in an all-round way and spatter and overflow. Dissolve egg white from three eggs in five *sheng* of cold water to make a mixture of liquid, and add it with a spoon slowly into the pot. The sugar syrup with the added mixture of liquid in the pot is heated slowly so that the impurities and scum will float to the surface. These are



【原文】

用自风慢火温之，看定火色然后入模。凡狮、象糖模，两合如瓦为之。杓泻糖入，随手覆转倾下。模冷糖烧，自有糖一膜靠模凝结，名曰享糖，华筵用之。

蜂 蜜

凡酿蜜蜂普天皆有，唯蔗盛之乡则蜜蜂自然减少。蜂造之蜜，出山崖、土穴者十居其八，而人家招蜂造酿而割取者，十居其二也。凡蜜无定色，或青或白，或黄或褐，皆随方土、花性而变。如菜花蜜、禾花蜜之类，千百其名不止也。凡蜂不论于家于野，皆有蜂王。王之所居，造一台如桃大，王之子世为王。王生而不采花，每日群蜂轮值分班采花供王。王每日出游两度（春秋造蜜时），游则八蜂轮值

【今译】

水口的小铜釜内，下面用煤粉慢火保温，看准火候后倒入模子中。做狮、象形状的糖模子，由两块像瓦一样的模件构成。用杓将糖液倒入模内，随手翻转模子，将兽糖倒出。因为模子冷而糖液热，自然会有一层靠近模子的糖膜凝结成相应形状，称为“享糖”，用于盛大的宴会。

蜂 蜜

酿蜜的蜜蜂到处都有，唯独盛产甘蔗的地方蜜蜂自然减少。蜂酿的蜜，出自山崖、土穴的野蜂占十分之八，而人工饲养的蜂占十分之二。蜂蜜没有固定颜色，或青或白，或黄或褐，皆随各地花性而变。如菜花蜜、禾花蜜之类，名目成百上千也不止。所有蜜蜂，不管是家蜂或野蜂，都有蜂王。蜂王所在之处，构筑一个如桃一样大的台。蜂王之子世代为王。蜂王生来就不采花，每日群蜂轮流分班采花供蜂王食用。蜂王每日出游两次（在春秋造蜜季节），出游时由



skimmed off with a rattan strainer. At this moment the sugar syrup will become very pure and white. Then put the sugar syrup into a small copper pot with handles and a water outlet. Keep it warm over a slow fire of coal powder. Then pour it into the mold when the duration and temperature are just proper. The mold for lion and elephant shapes is composed of two pieces of pottery that come together to form a complete mold. Pour the sugar syrup into the mold and turn the mold around so that the syrup will flow off to make the animal-shaped candies. Because the syrup is hot but the mold is cold, a layer of sugar close to the mold will naturally adhere to the interior of the mold and become solidified. The candies made this way are called "feast candies" and is used at banquets only.

Honey

There are honey bees throughout the country, but the number of honeybees is smaller in areas where large quantities of sugar cane are planted. Nearly 80% of the honey made by bees is contributed by the wild bees coming from cliffs or earthen caves, while the other 20% by the domestically raised honeybee. The color of honey is not fixed. It is green or white, yellow or brown, and changes according to the nature of the flowers in different places. The names of honey are varied: rape-flower honey, grain-flower honey, and hundreds of other varieties. Every swarm of bees, whether wild or domestic, has a queen bee. There is a chamber as big as a peach in the hive where the queen bee lives. It is said that the descendants of the queen will become the queens of bees generation after generation. The queen bee never collects pollen. Instead, a herd of bees collects pollen to feed her in turn every day. The queen bee goes on a tour twice a day (in spring and autumn when honey is to



【原文】

以待。蜂王自至孔隙口，四蜂以头顶其腹，四蜂傍翼，飞翔而去。游数刻而返，翼顶如前。

畜家蜂者或悬桶檐端，或置箱牖下。皆锥圆孔眼数十，俟其进入。凡家人杀一蜂、二蜂皆无恙，杀至三蜂则群起而螫之，谓之蜂反。凡蝙蝠最喜食蜂，投隙入中，吞噬无限。杀一蝙蝠悬于蜂前，则不敢食，俗谓之梟令。凡家畜蜂，东邻分而之西舍，必分王之子而去为君，去时如铺扇拥卫。乡人有撒酒糟香而招之者。

凡蜂酿蜜，造成蜜脾，其形鬣鬣然。咀嚼花心汁吐积而成，润以人小遗，则甘芳并至，所谓“臭腐生神奇”也。凡割脾取蜜，蜂子多死其中，其底则为黄蜡。凡深山崖石上，有经数载未割者，其蜜已经时自熟，土人以长竿刺取，蜜即流下。或未经年而攀缘可取者，割炼与家蜜同也。土穴所酿多出北方，南方卑湿，有崖蜜而无穴蜜。凡蜜

【今译】

八只蜂轮换服侍。蜂王行至巢口，有四只蜂以头顶蜂王腹部，另四只蜂围着蜂王飞翔而去。游不多久就返回，照先前那样顶着腹部、护卫蜂王回巢。

养家蜂的人将桶悬挂在屋檐一头，或者将箱子置于窗下。桶或箱上要钻几十个圆孔，让蜂进入其中。家人打死一二只蜂都无妨，但打死三只蜂以上时，蜜蜂就会群起螫人，叫做“蜂反”。蝙蝠最喜欢吃蜜蜂，如乘机钻进蜂巢，便会吃掉无数蜜蜂。杀一蝙蝠悬于蜂桶前，别的蝙蝠就不敢再食，俗话叫杀一儆百。家养蜂分群到另一处时，必须把新的母蜂分出去成为蜂王，群蜂排成扇形拥卫新的蜂王飞走。乡人有撒酒糟的，用其香气招引蜂群分房。

蜜蜂酿蜜时，先造成蜜脾，其形状像排列整齐的鬃毛。蜜蜂咀嚼花心汁液，吐积而成蜜，再以人尿滋润，则蜂蜜甘甜而芳香，这就是所谓“臭腐生神奇”。取下蜜脾提制蜂蜜时，幼蜂多死于其中，底部则为黄色蜂蜡。深山岩石上有经数年未割取下来的蜜脾，其中的蜜早就成熟了。当地人用长竿子将其刺破，蜜就会流下来。也有的蜜脾不足一年，而人可爬上去割取，与家蜂蜜的割炼方法相同。土穴中所酿



be made) with eight bees attending her in turn. The queen bee by herself goes to the opening of the bee hive and flies off, with four attendant bees supporting her belly with their heads, while another four other bees flying beside her. After flying for a few hours, they return to the beehive with the eight bees accompanying the queen the way they fly off.

People raising bees often hang a barrel on the side of an eave or put a box under a window. The barrel or box should be drilled about ten holes for letting the bees enter. It is no harm for the breeder to kill one or two bees but if three bees get killed, all the bees will rally together to bite people, which is called “bee rebellion”. The bat likes eating honeybees most, so if it seizes the opportunity to creep into bee’s hive it will eat up countless honeybees. Hanging one dead bat in front of the barrel will scare away all the other bats, which is called “executing one as a warning to a hundred” in the old saying. When hiving a swarm into another place, a new queen should be picked to be the queen of the new group. The swarm of bees will arrange into a fan-shape to safeguard the queen to fly away. Some villagers often spread the wine around in order to help hiving off the bees with its fragrance.

When honeybees make honey, they will build up honeycombs at first. The honeybees collect the nectar of the flowers and spit it out to accumulate into honey. To get the honey, the honeycomb is cut open, which will kill most of the young bees inside. The yellow beeswax is found at the bottom of the honeycomb. On the rock of remote mountains there are some honeycombs that have never been taken out for many years and are fully ripened for harvesting. The local people often prick them with a long bamboo pole and then the honey will flow out. People can climb up to reach the honeycombs which are less than one



【原文】

脾一斤炼取十二两。西北半天下，盖与蔗浆分胜云。

饴 飴

凡饴飴，稻、麦、黍、粟皆可为之。《洪范》云：“稼穡作甘。”及此乃穷其理。其法用稻、麦之类浸湿，生芽暴干，然后煎炼调化而成。色以白者为上。赤色者名曰胶饴，一时宫中尚之，含于口内即溶化，形如琥珀。南方造饼饵者谓饴飴为小糖，盖对蔗浆而得名也。饴飴人巧千方以供甘旨，不可枚述。唯尚方用者名一窝丝，或流传后代，不可知也。

【今译】

的蜜多出北方，南方地势低又潮湿，只有崖蜜而无穴蜜。一斤蜜脾可炼取十二两蜜。西北地区产的蜂蜜占全国一半，可与南方的蔗浆匹敌。

饴 糖

饴糖用稻、麦、黍、粟都可以制造。《尚书·洪范篇》云：“粮食可以产生甜味。”从这里可了解其中的道理。方法是将稻、麦之类浸湿，生芽后晒干，然后煎炼调化而成。白色的是上等品。赤色的叫胶饴，一时在宫中受到重视，含在口中即溶化，形状像琥珀。南方制造糕点的人，把饴糖叫做小糖，这是针对蔗糖而取的名。人们通过技巧将饴糖制成很多甜食品，不胜枚举。唯有宫内食用的名为“一窝丝”的品种，是否流传下来便知道了。



year old. The way of extracting is the same as getting domestic honey. The honey coming from the bee combs in earthen caves exists mostly in North China while because of the low terrain and wet atmosphere in the south there is only honey from the bee combs on the cliffs but none from the bee combs in the caves. One *jin* of honeycomb will produce 12 *liang* of honey. Honey produced in the northwestern China takes up half of the whole country's production, which is equal to the amount of sugar cane syrup in the south.

Maltoses

Maltose can be made from rice, wheat, glutinous millet or millet. According to the Chapter of Grand regulations in *The Book of History*: The sweet taste of maltose comes from grains. The method of making maltose is soaking the grains of wheat or rice and the like in water and allowing them to sprout. Then dry them in the sun and boil them to make maltose. The white parts are of the prime quality, while the red ones are the so-called glue maltose, which once was very popular in the palace in ancient times. The glue maltose looks like the amber and melts as soon as it is put in the mouth. People making maltose in the south call it malt sugar to distinguish it from cane sugar. People use a lot of techniques to make maltose into various kinds of sweet food, which can not be enumerated here. There is a variety called "nest of silken threads" which is used exclusively by the imperial household. No one knows whether the method of preparing this particular sweetmeat has been passed down to the later generations or not.



膏 液 第 五

【原文】

宋子曰，天道平分昼夜，而人工继晷以囊事，岂好劳而恶逸哉？使织女燃薪、书生映雪，所济成何事也？草木之实，其中蕴藏膏液，而不能自流。假媒水火，凭借木石，而后倾注而出焉。此人巧聪明，不知于何禀度也。人间负重致远，恃有舟车。乃车得一铢而辘转，舟得一石而罅完，非此物之功也不可行矣。至菹蔬之登釜也，莫或膏之，犹啼儿之失乳焉。斯其功用一端而已哉。

油 品

凡油供饌食用者，胡麻、莱菔子、黄豆、菰菜子（一名白菜）为上。苏麻（形似紫苏，粒大于胡麻）、芸苔子（江南名菜子）次之，楸子（其树高丈余，子如金樱子，去肉取仁）次之，蓖菜子次之，大麻仁（粒如

【今译】

宋子说，按自然规律一天要平分为白昼与黑夜，而人们却点油灯夜以继日地工作，是否可理解为爱好劳动而厌恶安逸？如果让织女借燃柴的光亮而织布，让书生在雪光映照下读书，又能做成什么事呢？草木的果实中蕴藏着油脂，但不会自行流出，要通过人借助水火之力，凭借木榨和石磨作用于草木子实，而后才能倾注而出油。人的这些技巧和聪明，也不知是如何传下来的。人间将重物运到远处，要靠舟车。而车要有一点油润滑，轮子才可转动；船要用大量油类才能堵塞缝隙。没有油是做不到这些的。至于在锅内烹饪，要是没有油，就像婴儿失奶一样，不能烧菜。这不过是油料功用的一个方面而已。

油 料 种 类

食用的油以芝麻（一名脂麻）、萝卜子、黄豆、菰菜子（一名白菜）为上品，而苏麻（形似紫苏，粒大于芝麻）、芸苔子（江南名菜子）次之，楸子（其树高丈余，子如金樱子，去肉取仁）次之，蓖菜子次之，大



Chapter 5

Oil and Fat Making

Songzi says that Nature divides time into day and night. However, people work day and night by using oil lamps. Can we conclude by this phenomenon that people like working and hate leisure? If women were to weave by light of the firewood and students were to study by the glow of snow, would they be successful? The seeds of grasses and trees are rich in oil, which can't flow out by itself. When people do something to the seeds of grasses and trees with the help of the forces of water and fire and the pressure of wooden and stone utensils, the oil will come out. We don't know how the skills and the wisdom of the ancient people are handed down from one generation to another. People transport the heavy objects to distant places by using boats and carts. It takes a little oil for the wheels to move. It takes a lot of oil to jam the chink of a boat. Thus, neither carts nor boats can move without oil. Cooking without oil is like letting an infant go without milk. This is only one of the functions of oil.

Types of Oil

For eating purposes, the oils made from sesame seeds, turnip seeds, yellow soybeans, and cabbage (also called white cabbage) seeds are of the top grade; the second grade of oil is *Perilla ocymoides* oil (the plant resembles *Perilla mankinensis* but its seed is bigger than that of sesame) and rape-seed oil (also called "vegetable seed" in the south); the third is the camellia or tea-seed oil (this tree is over ten feet high, and its seed is like poppy



【原文】

胡荽子，剥取其皮，为索用者）为下。

燃灯则柏仁内水油为上，芸苔次之，亚麻子（陕西所种，俗名壁虱脂麻，气恶不堪食）次之，棉花子次之，胡麻次之（燃灯最易竭），桐油与柏混油为下（桐油毒气熏人，柏油连皮膜则冻结不清）。造烛则柏皮油为上，蓖麻子次之，柏混油每斤入白蜡冻结次之，白蜡结冻诸清油又次之，樟树子油又次之（其光不减，但有避香气者），冬青子油又次之（韶郡专用，嫌其油少，故列次）。北土广用牛油，则为下矣。

凡胡麻与蓖麻子、樟树子，每石得油四十斤。莱菔子每石得油二十七斤（甘美异常，益人五脏）。芸苔子每石得油三十斤，其耨勤而地沃、榨法精到者，仍得四十斤（陈历一年，则空内而无油）。榛子每石得油一十五斤（油味似猪脂，甚美，其枯则只可种火及毒鱼用）。桐子仁每石

【今译】

麻仁（粒如胡荽子，剥取其皮，皮可制绳索）为下品。

燃灯用的油以柏仁中的水油为上品，其次是油菜子油、亚麻子油（陕西所种的，俗名“壁虱脂麻”，气味不好，不堪食用），其次是棉花子油、芝麻油（点灯最易消耗），桐油与柏的混油为最次（桐油毒气熏人，柏油带皮膜则凝结而不清）。造蜡烛则以柏皮油为最好，其次是蓖麻子油、柏混油每斤加入白蜡而凝结的，再其次是加白蜡而凝结的各种清油，樟树子油又次之（点燃时其光不弱，但有人不喜欢其气味），冬青子油又次之（韶州府专用，嫌其含油量少，故列入次等）。北方蜡烛广泛用牛油，则为下等油。

用芝麻、蓖麻子与樟树子每石可榨油四十斤。萝卜子每石得油二十七斤（味甘美异常，益人五脏）。油菜子每石得油三十斤，如除草勤而地肥沃、榨法精到者，仍得油四十斤（要是放置一年，则子实内空而无油）。榛子每石得油一十五斤（油味似猪油，甚美，其枯饼则只可引火及毒



seed, which should be shelled and its oil is obtained from the kernel); the fourth is *Amarantus mangostanus* oil, and the oil of the lowest grade is the hemp-seed oil (the skin of the hemp plant is used to make rope, and only the seed which resembles caraway seed is used to make oil).

For lighting purposes, lamp oil made from the kernels of the vegetable tallow-tree seeds is of the top grade, followed by rape-seed oil, linseed oil (which is planted in Shaanxi Province and locally called "louse sesame", and it has a bad odor and is inedible), cotton-seed oil and sesame oil (which burns off quickly in the lamp), while tung oil (the Chinese-wood oil) and "mixed" vegetable tallow-seed oil are of the lowest grade (The poisonous odor of tung oil is sickening, and the mixed vegetable tallow-seed oil tends to solidify and appear turbid.) For making candles, the best oil is "unmixed" vegetable-tallow fat, followed by castor oil, "mixed" vegetable tallow-seed oil solidified by adding a certain amount of white wax, the various clear oils solidified with the admixture of white wax, camphor seed oil (though it gives no less light than the other types of oil, some people don't like its scent), and next, holly-seed oil (which is exclusively used in Shaozhou Prefecture in Guangdong Province and rated low on the list because it contains less oil). People in the North China use beef fat to make candles, which are of the lowest quality.

Forty *jin* of oil can be extracted from one *dan* of sesame seeds, castor seeds and camphor seeds; and one *dan* of turnip seeds produce twenty-seven *jin* of oil (this oil is palatable and good for the internal organs). One *dan* of rape seeds can produce thirty *jin* of oil, but the production of oil can be forty *jin* if the land where the rape is planted is fertile and the plants are weeded frequently or the seeds are thoroughly extracted. (But if the seeds are stored for one year, they will be dry and oilless.) Every *dan* of tea or camellia seeds can produce fifteen *jin* of oil (the oil tastes like lard and is



【原文】

得油三十三斤。柏子分打时，皮油得二十斤、水油得十五斤，混打时共得三十三斤（此须绝净者）。冬青子每石得油十二斤。黄豆每石得油九斤（吴下取油食后，以其饼充豕粮）。菘菜子每石得油三十斤（油出清如绿水）。棉花子每百斤得油七斤（初出甚黑浊，澄半月清甚）。苋菜子每石得油三十斤（味甚甘美，嫌性冷滑）。亚麻、大麻仁每石得油二十余斤。此其大端，其他未穷究试验，与夫一方已试而他方未知者，尚有待云。

法 具

凡取油，榨法而外，有两瓩煮取法，以治蓖麻与苏麻。北京有磨法，朝鲜有舂法，以治胡麻。其余则皆从榨出也。凡榨，木巨者围必合抱，而中空之。其木樟为上，檀、杞次之（杞木为者防地湿，则速

【今译】

鱼用)。桐子仁每石得油三十三斤。将乌柏子实及外壳分开榨油，则得皮油二十斤、水油十五斤；混在一起榨油，则共得三十三斤（子皮必须很干净）。冬青子每石得油十二斤。黄豆每石得油九斤（吴下地区取油食用，以豆饼作猪饲料）。白菜子每石得油三十斤（油澄清后像绿水似的）。棉子每百斤得油七斤（刚出油时色甚黑浊，放半月后便澄清）。苋菜子每石得油三十斤（味甚甘美，但嫌性滑）。亚麻、大麻仁每石得油二十余斤。以上这些是大致情况，其他未做穷究试验，或者有的在某地已做试验而在其他地方还不知道的，尚有待查考。

榨油工具及方法

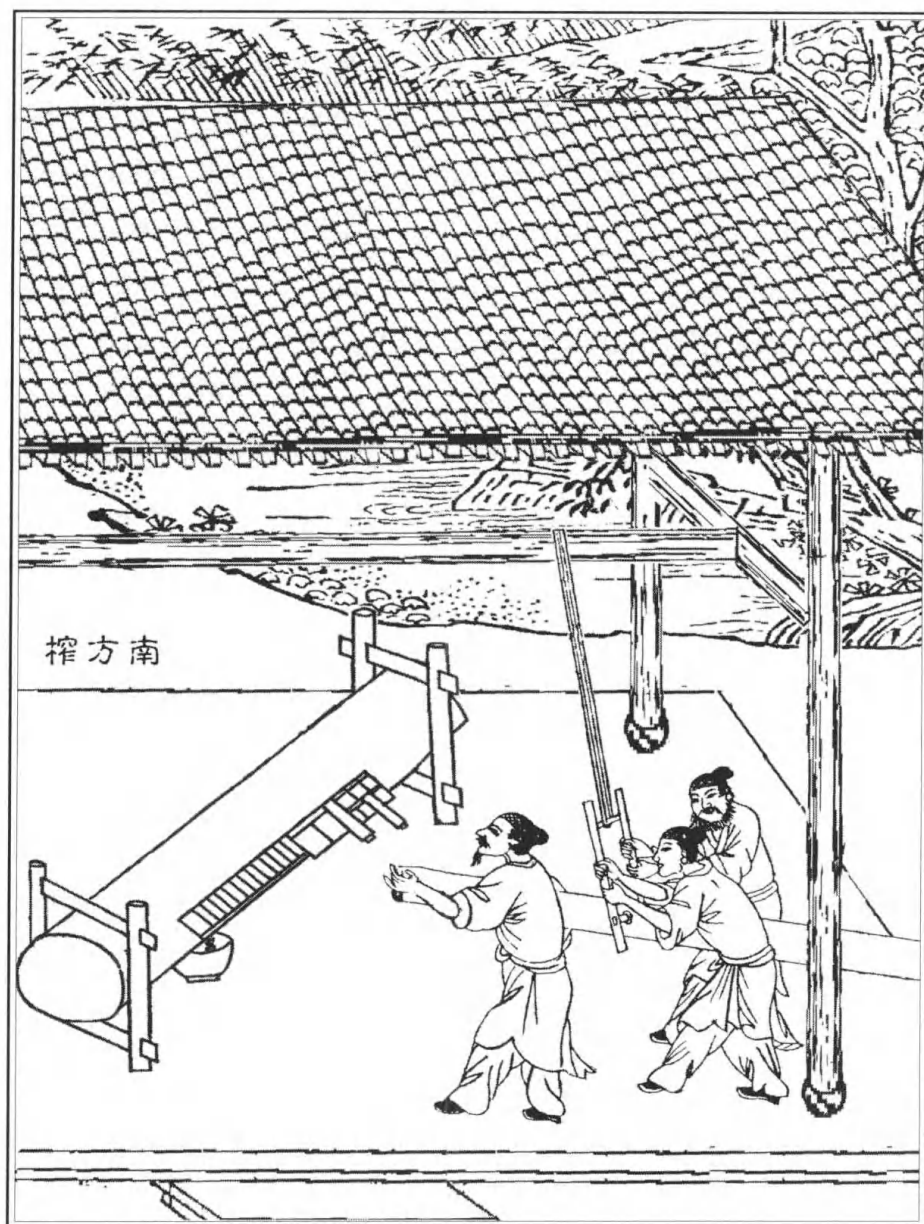
制取油料时，除榨法以外，还有用两口锅煮以处理蓖麻与苏麻的方法。北京有磨法、朝鲜有舂法来处理芝麻。其余的都是用榨法来制取。用巨木做的榨，围粗必须用双手可以合抱的，将其中间挖



very delicious and the dry cakes of the camellia seeds can be used as firewood or fish poison), while every *dan* of tung tree seeds can produce thirty-three *jin* of oil. When the tallow hulls and kernels of the Chinese vegetable-tallow tree seeds are pressed separately, twenty *jin* of “unmixed” tallow fat and fifteen *jin* of kernel oil can be produced. But if the seeds are not pressed separately, only thirty-three *jin* of “mixed” tallow seed oil can be obtained, (but the seeds and hulls should be very clean). Each *dan* of holy seeds can produce twelve *jin* of oil; one *dan* of yellow soybeans can produce nine *jin* of oil (in the Wuxia locality, which is part of southern Jiangsu and northern Zhejiang Provinces nowadays, the bean oil is used for humans, and the cakes are used to feed the pigs); one *dan* of cabbage seeds can produce thirty *jin* of oil (the oil appears limpid as greenish water). Every hundred *jin* of cotton seeds can produce seven *jin* of oil (the oil is dark and not clear when first pressed out, but becomes clear after half a month). Thirty *jin* of oil can be produced from one *dan* of *Amarantus* seeds (this oil tastes good, but is rather cold and laxative in nature), and more than twenty *jin* of oil can be produced from linseeds or hemp seeds. The above is a list of the main types of oil, and this means that no test is done on other types of oil. Even though the properties of some types of oil have been tested, they are still unknown to people in other places.

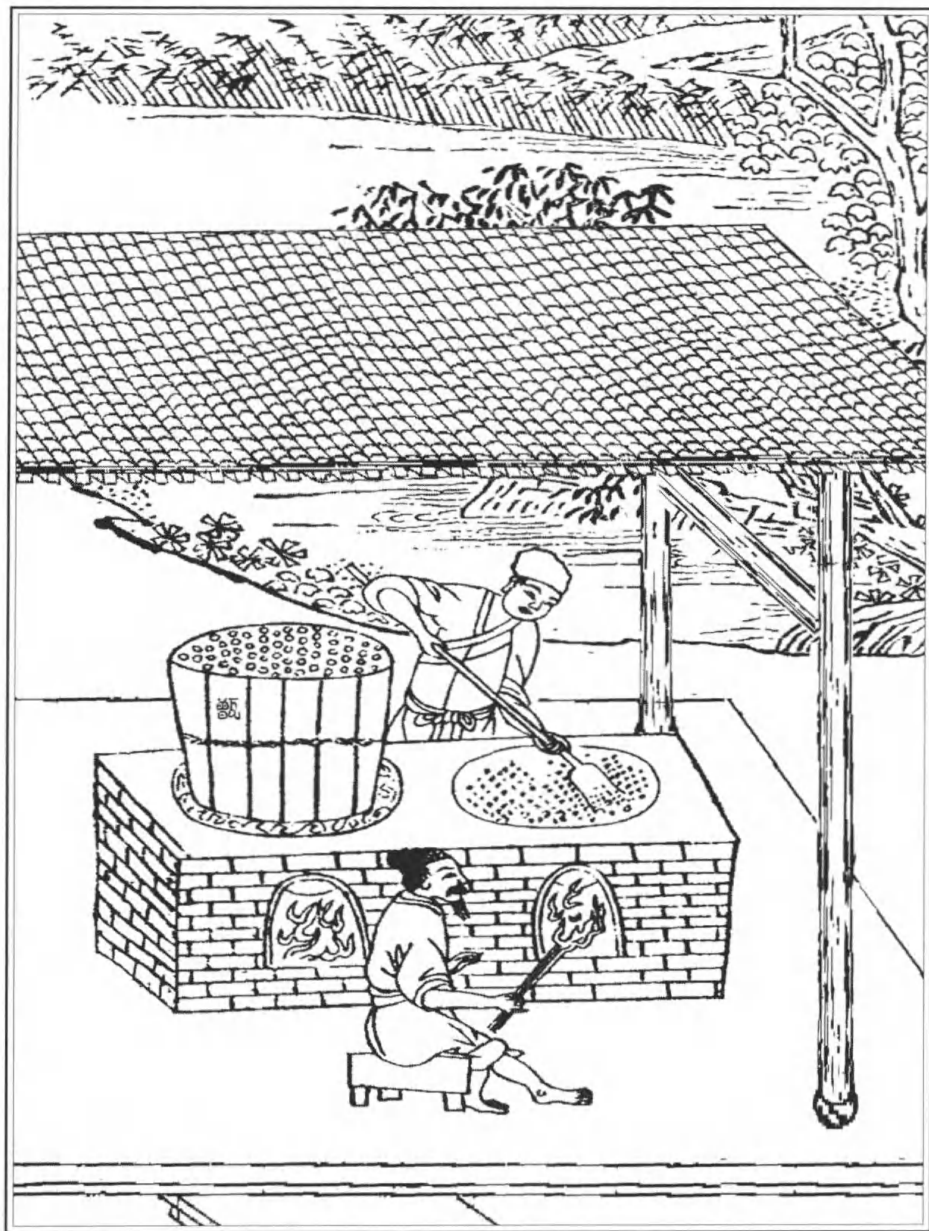
Tools and Methods for Extracting Oil

In addition to the method of pressing for getting oil, boiling the castor-oil plants and *Perilla ocymoides* oil with two cauldrons is also a widely used method of extracting oil. In Beijing, people usually grind the same seeds to extract oil, but in Korea people often obtain the sesame oil by pounding the sesame seeds with a pestle or mortar. The residue can be obtained by extraction. The large timber for making an



南方榨

Press for making vegetable oil in South China



炒蒸油料

Roasting (right) and steaming (left) oil seeds



【原文】

朽)。此三木者脉理循环结长，非有纵直纹。故竭力挥椎，实尖其中，而两头无璺拆之患。他木有纵文者不可为也。中土江北少合抱木者，则取四根合并为之，铁箍裹定，横栓串合而空其中，以受诸质。则散木有完木之用也。

凡开榨空中，其量随木大小，大者受一石有余，小者受五斗不足。凡开榨辟中凿划平槽一条，以宛凿入中，削圆上下，下沿凿一小孔，刷一小槽，使油出之时流入承藉器中。其平槽约长三四尺，阔三四寸，视其身而为之，无定式也。实槽尖与枋唯檀木、柞子木两者宜为之，他木无望焉。其尖过斤斧而不过刨，盖欲其涩，不欲其滑，惧报转也。撞木与受撞之尖，皆以铁圈裹首，惧披散也。

【今译】

空，木料以樟木为上，其次是檀木与杞木（杞木做的榨，怕地面潮湿，易于腐朽）。这三种木料的纹理呈长圆形圈状，一圈围着一圈，没有纵直纹。这样将尖楔插入其中，极力捶打，两端才没有断裂之患。其他木料有纵纹的，则不可用。中原江北地区较少有合抱木，则取四根木拼合成榨，用铁箍包紧，再用横栓串合起来，并将其中间挖空，以放各种榨油原料。因此散木也有完木的功用。

做榨时要将木料中间掏空，中间挖空多少要看木料的大小，大的可装料一石多，小的装不到五斗。做榨时还要在木料中空部分开一条平槽，用弯凿在木料里面上下削圆，下沿再凿出一个小孔。再削出一个小槽，使油榨出时流入承受器中。平槽约长三四尺，宽三四寸，视木料大小而定，没有固定的形式。装在槽里的尖楔与枋，只有用檀木、柞木做才合适，其他木料是不行的。尖楔用刀斧砍成，不必刨过，取其粗涩而不令其光滑，以免滑动。撞木与受撞的尖楔都要用铁圈包住头部，以免木料披散。



oil press must be an armful in diameter and hollowed in the center. Camphor wood is best suited for this purpose, followed by sandalwood and alder wood (A press made of alder wood will rot rapidly if the moisture from the ground is not eliminated). The grains of these trees are circular and spiral and do not run up and down vertically. Thus, the wood will not split at the ends even if the center post is heavily hammered with a pointed wedge. In the north of the Yangtze River, timber with such large dimensions is rarely seen. In that case, four pieces of wood can be joined together by using iron hoops. The center portion is hollowed out so that the raw materials for making oil can be put inside. Thus small pieces of wood can also function as large timber to make an oil press.

As is mentioned above, when the oil press is made, the center of the wood should be hollowed out. But the size of the hollow depends on the dimension of the wood. The big ones can hold more than one *dan* of raw materials while the small ones can hold less than five *dou*. When making the press, cut a trench in the hollow and scoop out the wood with a curved chisel so that the hollowed trench is a long one with rounded ends. Then drill a small hole at the bottom and cut another small trench so the squeezed oil can flow out into a container. The flat trench is about three or four *chi* long, and three or four *cun* wide depending on the size of the timber, and therefore there is no fixed dimension of it. The pressing wedge and ram installed inside the timber can only be made of sandalwood or oak. Any other type of wood will not be suitable. The tip of the wedge is sharpened with a knife or an axe, and it does not need to be polished because the rough surface will prevent it from sliding. The ramming wood and the wedge should be both hooped with iron rings to keep them from breaking.



【原文】

榨具已整理，则取诸麻、菜子入釜，文火慢炒（凡柏、桐之类属树木生者，皆不炒而碾蒸），透出香气，然后碾碎受蒸。凡炒诸麻、菜子，宜铸平底锅，深只六寸者，投子仁于内，翻拌最勤。若釜太深，翻拌疏慢，则火候交伤，减丧油质。炒锅亦斜安灶上，与蒸锅大异。凡碾埋槽土内（木为者以铁片掩之），其上以木杆衔铁陀，两人对举而推之。资本广者则砌石为牛碾，一牛之力可敌十人。亦有不受碾而受磨者，则棉子之类是也。既碾而筛，择粗者再碾，细者则入釜甑受蒸。蒸气腾足取出，以稻秸与麦秸包裹如饼形，其饼外圈箍或用铁打成，或破篾绞刺而成，与榨中则寸相吻合。

凡油原因气取，有生于无。出甑之时包裹怠慢，则水火郁蒸之气游走，为此损油。能者疾倾、疾裹而疾箍之，得油之多，诀由于此。榨工有自少至老而不知者。包裹既定，装入榨中，随其量满，

【今译】

榨具既已整备，则将各种麻子或菜子放入锅中，用文火慢炒（凡柏、桐之类树上生的，均不必炒，而是碾碎后蒸之），待透出香气，然后碾碎再蒸。炒各种麻子、菜子时，宜用铸造的平底锅，深仅六寸左右。将子仁投入锅中，不停地翻拌。如果锅底太深、翻拌疏慢，则火候不匀，会损伤油质。炒锅斜安在灶上，与蒸锅大不相同。碾槽埋在土内（木制的则用铁片包起），上面用木杆穿个圆铁饼，两人对举而推碾。资本宽裕的则用石料做成碾，再用牛拉。一牛之力可抵十人。也有不用碾而用磨的，如棉子之类。碾后过筛，择粗的再碾，细的则入锅受蒸。蒸气透足物料后取出，将其用稻秸或麦秸包裹成饼状。饼外边的圆箍用铁打成，或用竹篾绞成。饼箍尺寸要与榨的中间空槽大小相符合。

油料中的油是通过气提取出来的，似乎是油生于气。出甑的时候，若包裹怠缓，则水火集结之气逸走，这样便会使油损失。操作熟练的人则快倒、快裹、快箍，得油较多的诀窍便在这里。榨工有从小到老都不知此理的。包裹完毕，便可装入榨中，根据其量大小而装满



After the press is made, put one kind of seeds or another into a pan and roast them with moderate heat (seeds from trees, such as those from sapium and the tung trees, are rolled and steamed without roasting) until a fragrant scent comes out. Then grind them into fine fragments and steam them. A flat-bottomed pan of no more than six *cun* deep would be the best choice for roasting these seeds. The seeds and kernels in the pan should be turned over and over again. The pan should not be too deep and the seeds should be stirred and turned over repeatedly. If not, the heat will be uneven and damage the quality of the oil. The pan should be fixed obliquely on the stove which is different from the steaming pot.

The trough of a rolling mill should be buried in the ground. A round iron roller with a wooden pole passing through it should be placed on top of the trough. Two workers facing each other push the pole to make it go around for grinding seeds. The rolling mill can be made of stones and pulled by oxen if there is enough money for it. The strength of one ox is equal to that of ten men. Some seeds, such as cotton seeds and the like, are ground instead of being rolled. Sieve the coarser fragments out of the rolled seeds and grind them again. Those small particles can be steamed and when they are saturated with vapor, take them out and wrap them up in rice or wheat stalks to form the shape of round cakes. The round hoop around the cake-shaped particles is forged with iron or made from twisted bamboo. The size of the hoop should fit the hollow of the press.

The oil is actually obtained from the vapor of the raw materials by steaming, and the oil seems to be extracted just in the time the vapor rises from the steamer. If the steamed raw materials are not wrapped in a timely manner, the oil contained in the vapor will evaporate at once



【原文】

挥撞挤轧，而流泉出焉矣。包内油出滓存，名曰枯饼。凡胡麻、莱菔、芸苔诸饼，皆重新碾碎，筛去桔芒，再蒸、再裹而再榨之。初次得油二分，二次得油一分。若柏、桐诸物，则一榨已尽流出，不必再也。

若水煮法，则并用两釜。将蓖麻、苏麻子碾碎，入一釜中注水滚煎，其上浮沫即油。以杓掠取，倾于干釜内，其下慢火熬干水气，油即成矣。然得油之数毕竟减杀。北磨麻油法，以粗麻布袋挾绞，其法再详。

皮 油

凡皮油造烛，法起广信郡。其法取洁净柏子，囫囵入釜甑蒸，蒸后倾于臼内受舂。其臼深约尺五寸，碓以石为身，不用铁嘴。石取深山结而腻者，轻重斫成，限四十斤，上嵌横木之上而舂之。其皮膜上油尽脱骨而纷落，挖起，筛于盘内，再蒸，包裹、入榨皆同前

【今译】

榨槽。然后挥撞挤压，油就像泉水那样流出。包裹里面的油出尽后，剩下油滓，名曰“枯饼”。芝麻、萝卜子、油菜子等的枯饼，都可以重新碾碎，筛去桔芒后再蒸、再裹、再榨。第二次得油为初次的一半。如是柏、桐等物，则榨一次油已流尽，不必再榨。

如果用水煮法，则并用两口锅。将蓖麻、苏麻子碾碎，放入一口锅中，加水煮沸，其上浮沫便是油。用杓取出，倒入另一口干的锅中，锅下用慢火熬干水分，便成油了。然而得油的数量毕竟减低。北方用磨提取芝麻油，将磨过的油料放入粗麻布袋中扭绞，其法待日后详考。

皮 油

用柏皮油造蜡烛的方法，起于广信。其方法是将洁净的柏子整个儿地放入甑里面蒸。蒸后倒在臼内舂捣。臼深约一尺五寸，碓身为石制，不用铁嘴。石料取自深山中结实而细滑的，斫成后重量限定为四十斤，上部嵌在横木之上，便可舂捣。其表皮内油脂层都离

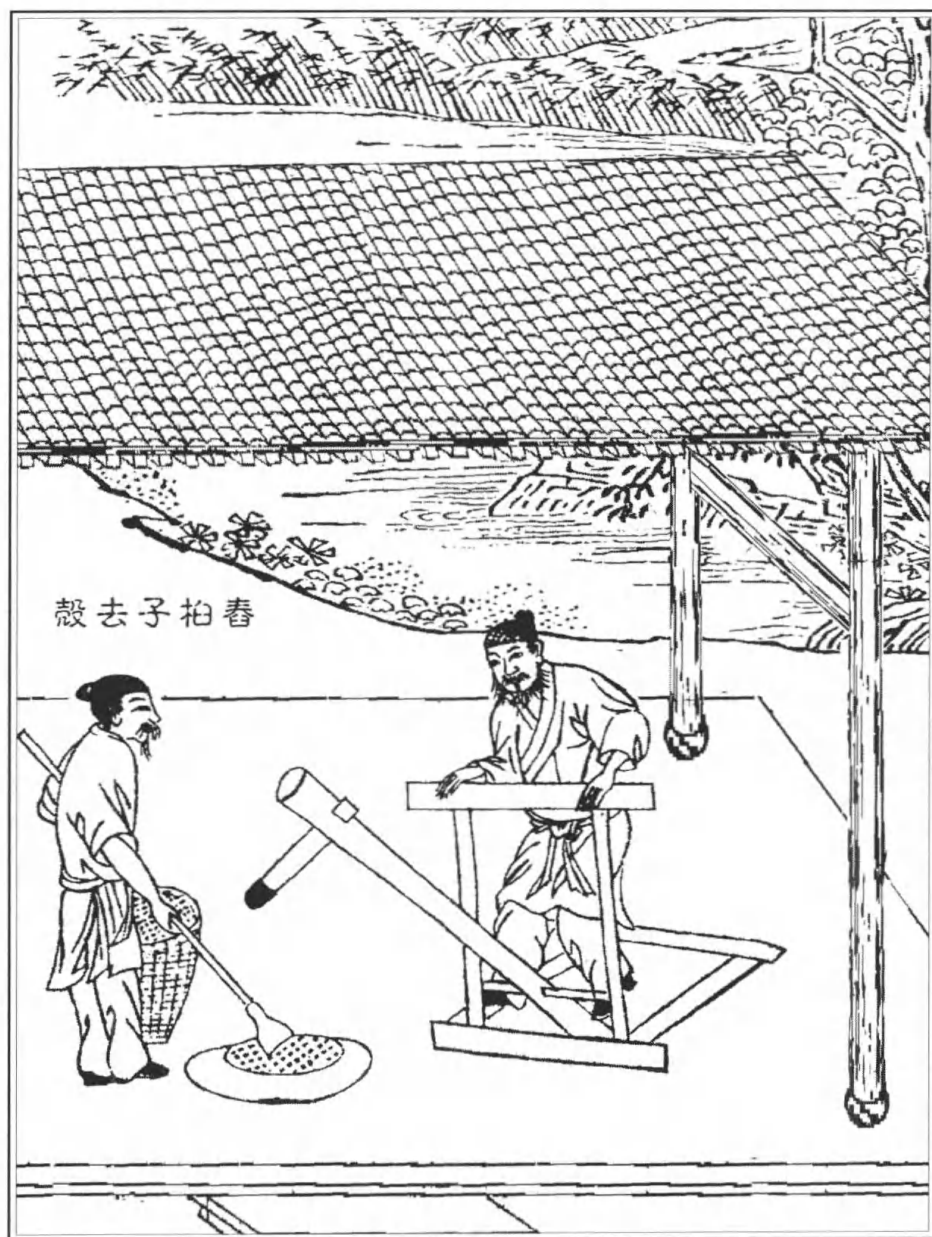


and some of the oil will be lost. The skillful workers will pour, wrap and tie them up very quickly, which is just the secret of getting oil from the seeds. Some of the workers who have worked on this job for a lifetime do not know this secret. When the packing is finished, put them in an appropriate amount into the press. Then squeeze them until the oil flows out like springs. When the oil is extracted completely, the oil residue, which is called "pressed cakes", will appear. The oil residue of the sesame, turnip seeds, rapeseeds, etc. can be re-ground after the stalks are sieved out, and then get re-wrapped and re-squeezed. Half the amount of oil can be produced in the second pressing. The Chinese vegetable-tallow and tung seeds do not need to be re-pressed because one time is enough to get all the oil out of them.

Two pots are needed for boiling seeds or kernels with water. Put the castor seeds or *Perilla ocymoides* seeds into a cauldron with water and boil them. The foam floating on the surface is the oil. Take the seeds out with a scoop and pour into another dry cauldron. Cook them slowly until the water inside the pot is evaporated completely. The rest is oil. However the amount of oil is reduced consequently. In the north, people use a grinder to extract sesame oil. They often put the ground seeds into a gunny-bag and twist it to get the oil. This method is still unproven and needs to be explored in the future.

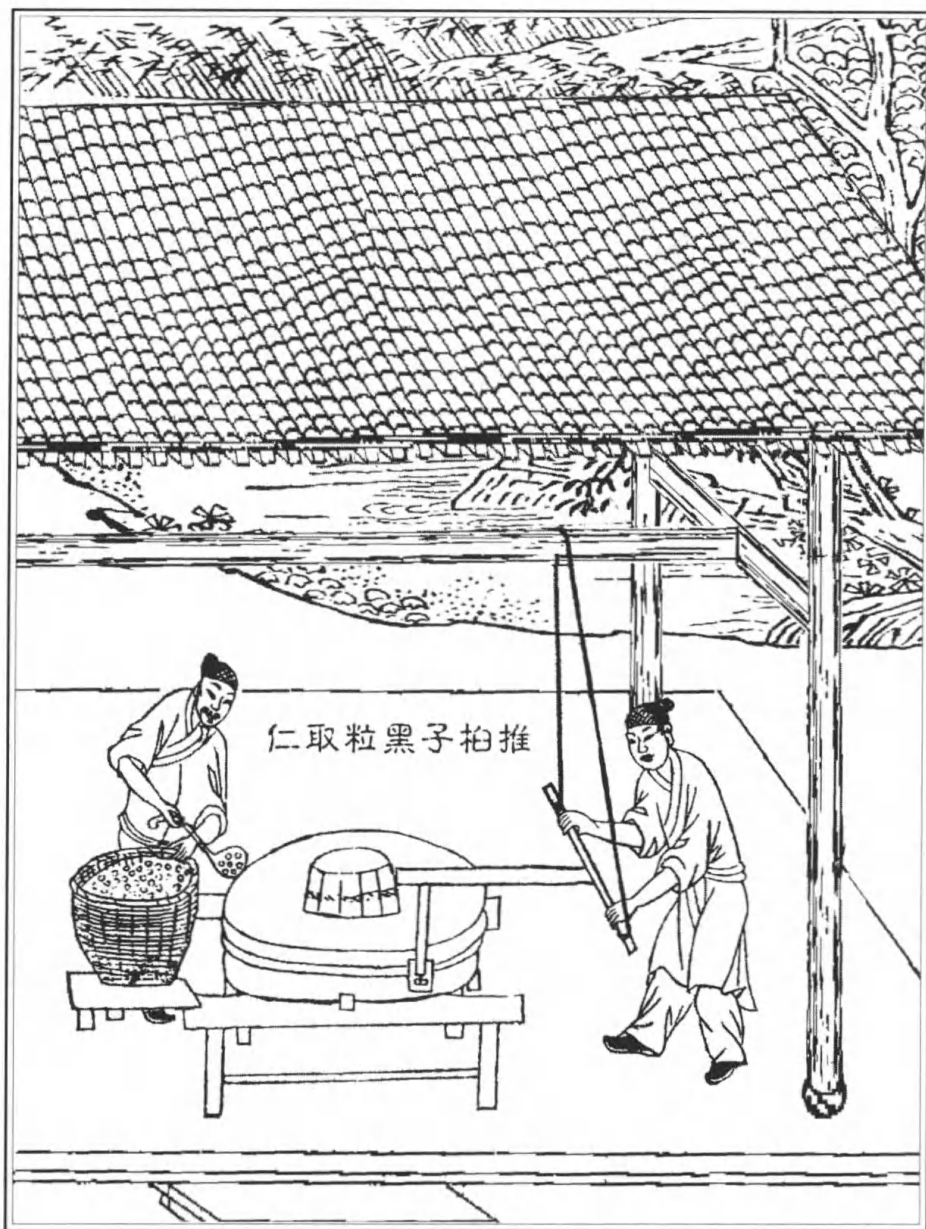
Making Candles with Vegetable-tallow Fat

Making candles with vegetable-tallow fat originated in Guangxin. First steam the tallow-tree seeds, together with their hulls, in a double boiler, then pound them with a white mortar and pestle. The mortar is about one *chi* and five *cun* deep, and the pestle is made of stone, with no iron cap. The stone obtained from remote mountains is very smooth



春搗去壳

Pounding vegetable tallow-tree seeds



轧磨取仁
Grinding vegetable tallow-tree seeds



【原文】

法。皮油已落尽，其骨为黑子。用冷膩小石磨不惧火煨者（此磨亦从信郡深山觅取），以红火矢围壅煨热，将黑子逐把灌入疾磨。磨破之时，风扇去其黑壳，则其内完全白仁，与梧桐子无异。将此碾、蒸，包裹、入榨与前法同。榨出水油清亮无比，贮小盏之中，独根心草燃至天明，盖诸清油所不及者。入食饌即不伤人，恐有忌者宁不用耳。

其皮油造烛，截苦竹筒两破，水中煮涨（不然则粘带），小篾箍勒定，用鹰嘴铁杓挽油灌入，即成一枝。插心于内，顷刻冻结，捋箍开筒而取之。或削棍为模，裁纸一方，卷于其上而成纸筒，灌入亦成一烛。此烛任置风尘中，再经寒暑，不敝坏也。

【今译】

开柏实而脱落，拾起，在盘内过筛后，再蒸。包裹、入榨，皆同前述之法。表皮的油脂层脱落后，其内核为黑子。用不怕火燒的冷滑的小石磨（做磨的石料，也是在广信府的深山中找到的），周围堆起烧红的炭火烘热，再将黑子逐把地投入磨中迅速磨破。在磨破时，用风扇去其黑壳，则剩下的全是里面的白仁，像梧桐子一样。将这种白仁碾碎、上蒸，包裹与入榨都与前法同。榨出的油叫水油，清亮无比。放在小灯盏中，用一根灯心草就可燃至天明，这种油为各种清油所不及。供作食用亦不伤人。但也有人忌食，宁肯不用。

用皮油造蜡烛的方法是，将苦竹筒竖破成两半，在水中煮涨（否则会粘带皮油），用小篾箍箍紧，用鹰嘴铁杓舀油灌入竹筒中，再将烛心插入其中，就成一支蜡烛。很快就凝结，将箍取下，打开竹筒将蜡烛取出。也可将木棍削成烛模。裁一张纸卷在木棍上做成纸筒，灌入皮油，也能制成蜡烛。这种蜡烛即使放在风尘中，历经寒暑，都不会变坏。



and durable. The mortar is about forty *jin* with a piece of wood on the top. Pick up the inside oil layer and sieve them for re-steaming. The wrapping and squeezing are done the way as mentioned above. A black core appears when the oil layer is off. Heat the stone mill (the stone used to make mills is obtained from the mountains in Guangxin) which is fireproof with burnt charcoal around to grind those black cores very quickly. When the cores are broken, blow away the black shells and then get the white kernels. Those kernels can be ground, steamed, wrapped and squeezed in the same way as mentioned above. The oil is called water oil, and it is incomparably pure. It will keep burning till daybreak with one rush in a small oil lamp. This type of oil is much better than all the other pure oils. There is no harm in people's eating it. However, some people do not like to eat it.

When making vegetable-tallow candles, first split a piece of bitter bamboo into two halves vertically and boil them with water till they are swollen (Otherwise the molten vegetable-tallow will stick to the bamboo.). Then hoop the two halves together and pour the oil into the bamboo tube which has a candlewick in the middle. The oil will condense very quickly. After that, take off the hoop and open the bamboo tube. The candle is done. The mold can also be made of sticks. Cut a piece of paper and roll it up in the shape of a wooden stick and fill in the leather oil. After the oil condenses the candle is done. This kind of candles will never corrode, even though they are exposed to the wind or stored for a long time.



乃服第六

【原文】

宋子曰，人为万物之灵，五官百体，赅而存焉。贵者垂衣裳，煌煌山龙，以治天下。贱者赍褐、枲裳，冬以御寒，夏以蔽体，以自别于禽兽。是故其质则造物之所具也。属草木者，为枲、麻、苘、葛；属禽兽与昆虫者，为裘、褐、丝、绵。各载其半，而裳服充焉矣。

天孙机杼，传巧人间。从本质而现花，因绣濯而得锦。乃杼柚遍天下，而得见花机之巧者，能几人哉？“治乱经纶”字义，学者童而习之，而终身不见其形象，岂非缺憾也！先列饲蚕之法，以知丝源之所自。盖人物相丽，贵贱有章，天实为之矣。

蚕种

凡蛹变蚕蛾，旬日破茧而出，雌雄均等。雌者伏而不动，雄者两

【今译】

宋子说，人为万物之灵，各种器官和肢体生得最为齐全。高贵的人穿着饰有山、龙等图案的华服以统治天下。卑贱者身着粗麻布衣服，冬以御寒，夏以蔽体，以有别于禽兽。这些衣服的原料都是大自然所提供的。属于植物一类的有棉、大麻、苘麻和葛；属于禽兽与昆虫之类的有皮、毛、丝、绵。两类各占一半，足够做衣服了。

像天上仙女织布那样的技巧，已在人间普及。从原料纺织成带有花纹的织物，更通过染色、刺绣而得到锦缎。虽然织机已遍布于天下，然而见过提花机纺织技巧的有多少人呢？与纺织有关的“治乱经纶”的词义，读书人从小就学过，而终生不见其形象，岂非缺憾之至！此处我们先叙述养蚕的方法，以使读者知道丝是从哪里来的。因为人和衣服相称，贵贱从衣服可以标志出来，这是自然的配合。

蚕种

蚕蛹变成的蚕蛾，经十天才破茧而出，雌蛾和雄蛾数目均等。



Chapter 6

Clothing Materials

Songzi says that man, whose organs and limbs are the best developed, is the highest of all forms of life on earth. The noble men wear clothes that are decorated with pictures of mountains and dragons and they rule the country. Low-status people wear linen clothes, so as to keep warm in winter and stay covered in summer, which differs them from animals. The raw materials of these clothes are supplied by Nature. Cotton, hemp, Chinese jute, and kudzu vine come from plants, and skin, fur, silk and silk floss come from animals and insects. Each makes up half of the raw materials which are necessary to make clothes.

The skill of weaving is popular throughout the country. People make textiles with flower patterns from raw materials, and even make brocade by dyeing and embroidering. Though spinning and weaving machines have been spread all over the country, how many people have seen the weaving skills of jacquard? Some people get some knowledge about weaving skills from books, but they have never seen the actual methods in their lifetime, which is really a pity. Here, at first, we introduce how to raise silkworms to help readers understand where silk is obtained. It is natural that man and clothes should match; his social status can be marked by his clothes.

Silkworm Eggs

It takes ten days for a chrysalis to change into a silkworm moth



【原文】

翅飞扑，遇雌即交，交一日、半日方解。解脱之后，雄者中枯而死，雌者即时生卵。承藉卵生者，或纸或布，随方所用。（嘉、湖用桑皮厚纸，来年尚可再用。）一蛾计生卵二百余粒，自然粘于纸上，粒粒匀铺，天然无一堆积。蚕主收贮，以待来年。

蚕 浴

凡蚕用浴法，唯嘉、湖两郡。湖多用天露、石灰，嘉多用盐卤水。每蚕纸一张，用盐仓走出卤水二升，掺水浸于盆内，纸浮其面（石灰仿此）。逢腊月十二即浸浴，至二十四日，计十二日，周即漉起，用微火烘干。从此珍重箱匣中，半点风湿不受，直待清明抱产。其天露浴者，时日相同。以篾盘盛纸，摊开屋上，四隅小石镇压。任

【今译】

雌蛾伏着不爱活动，雄蛾则两翅飞扑，遇到雌蛾就交配。雌雄交配要经一日、半日才相互解脱。解脱之后，雄蛾体内枯竭而死，雌蛾则即时生卵。承接蚕卵的材料，或者用纸，或者用布，因地制宜。（嘉兴、湖州用厚的桑皮纸，次年还可再用。）一只蛾产卵二百余粒，这些卵会自然地粘在纸上，粒粒均匀铺开，天然地没有堆积在一起。养蚕的人将蚕卵收贮起来，以待来年之用。

浴 种

蚕种用浴洗方法处理的，只有嘉兴、湖州两地。湖州多用天然露水、石灰浴蚕，而嘉兴则多用盐卤水浴。每张粘有蚕卵的纸，用盐仓内流出的卤水二升，掺水倒入盆内，让纸浮在水面上（石灰浴也仿照此法）。每逢腊月十二日即开始浸浴，至二十四日为止，共十二天，到时捞起蚕纸滴干水，用微火烘干。然后珍藏在箱盒里，不让半点风寒、湿气侵入，直待清明时孵化。用天然露水浴蚕，时间同上。用竹盘盛蚕纸，摊开放在屋顶上，四角用小石头压上。任其经受霜雪、风



and come out of its cocoon. There will be half female and half male moths. Female moths usually stay there, unwilling to move, while male moths flutter around. Female moths and male moths mate when they meet, and it will take a day or half a day before they separate from each other. After separation, the male moths' bodies die of exhaustion, while female moths lay eggs immediately. Place silkworm eggs on sheets of paper or on cloth, according to the local practice. (People in Ji-axing and Huzhou prefectures use thick paper made from mulberry bark which can be reused the next year, both are in the Lake Tai region in Zhejiang Province nowadays.) One moth can lay over two hundred eggs. These eggs adhere naturally to the paper in a single layer and never pile up. Silkworm farmers store these eggs for use in the next year.

The bathing of silkworm eggs

This method is only adopted in Jiaxing and Huzhou prefectures. People in Huzhou use dew and lime water to bath eggs. But people in Jiaxing usually use brine to bath eggs. Pour two *sheng* of brine mixed with water into a basin, then put a piece of paper with silkworm eggs on the water and let it float on the water. (It is the same as bathing with lime water.) Bathing begins from the twelfth day of the twelfth month on the lunar calendar and ends on the twenty-fourth, lasting twelve days altogether. After twelve days, take these pieces of paper out of the water to let the water drop, dry them with a weak fire and then keep them in cases or boxes away from wind or moisture until the next Pure Brightness, by which time the silkworm will be hatched. The bathing of silkworm eggs with dew is the same as that with brine. Put the paper on trays made of bamboo, spread them out on the roof, and press each of the four corners with a small stone. After twelve days of frost, snow,



【原文】

从霜雪、风雨、雷电，满十二日方收。珍重、待时如前法。盖低种经浴，则自死不出，不费叶故，且得丝亦多也。晚种不用浴。

种 忌

凡蚕纸用竹木四条为方架，高悬透风避日梁枋之上。其下忌桐油、烟煤火气。冬月忌雪映，一映即空。遇大雪下时，即忙收贮。明日雪过，依然悬挂，直待腊月浴藏。

种 类

凡蚕有早、晚二种。晚种每年先早种五六日出（川中者不同），结茧亦在先，其茧较轻三分之一。若早蚕结茧时，彼已出蛾生卵，以便再养矣（晚蛹戒不宜食）。凡三样浴种，皆谨视原记。如一错误，或将天露者投盐浴，则尽空不出矣。凡茧色唯黄、白二种，川、陕、

【今译】

雨、雷电，满十二天后收起。保存方式、时间与前述方法同。因为劣种经过浴洗，会自然死亡而不出幼蚕。这样处理后，不致浪费桑叶，收茧得丝也较多。晚蚕蚕种不用浴法。

蚕 种 禁 忌

用四条竹木棍做成方架，把蚕纸高挂在通风、避阳光的房梁上。其下部不要有桐油、烟煤火气，冬天忌雪光映照，否则蚕种就会变成空卵壳。遇下大雪时，赶快收贮起来。明日雪过，依然悬挂，直到腊月浴种后收藏。

蚕 的 种 类

蚕有早蚕、晚蚕两种。晚蚕每年比早蚕先孵出五六天（四川的蚕与此不同），其结茧也在早蚕之前，但其茧比早蚕茧轻三分之一。当早蚕结茧时，晚蚕已出蛾产卵，以供再养了（晚蚕蚕蛹不可食用）。用上述三种方法浴种，都要细心注意原来的标记，万一弄错，比如将已用天露水浴过的蚕种再行盐浴，则蚕种尽空而不会出蚕了。蚕茧有



wind, rain or thunder, put them away using the same method and the timing mentioned above. Because inferior eggs will die off naturally without producing silkworms, it can save mulberry leaves and get more silk. This method isn't used with silk-moth eggs of the late variety of silkworms.

Avoidances

After the silk-moth eggs are laid, the egg papers are held in the square frame made of four pieces of wood and hung up in breeze. The frames should be suspended from rafters and beams inside a house, so as to avoid the sun. Be sure that there is no tung oil, smoke or fire below them; there should be no snow light shining upon it, otherwise these silkworm eggs will become hollow. When it snows, put the paper away as soon as possible and hang it again the next day after the snow. This continues until the twelfth lunar month, when the eggs are put through the bathing process and then stored.

Types of silkworms

Silkworms can be divided into two types, the early silkworms and late silkworms. The late silkworms hatch five or six days ahead of early silkworms (silkworms in Sichuan are different). They also change into cocoons ahead of the early silkworms, but they are one third as light as the early silkworms. When the early silkworms become cocoons, the late ones have already turned into moths and laid eggs for further production. (The chrysalis of the late silkworms can not be eaten.) When using the above-mentioned three methods to bath them, be careful enough to avoid mistakes. If the silkworm eggs that have already been bathed in dew are bathed in brine again, the eggs will become hollow and cannot



【原文】

晋、豫有黄无白，嘉、湖有白无黄。若将白雄配黄雌，则其嗣变成褐茧。黄丝以猪胰漂洗，亦成白色，但终不可染缥白、桃红二色。

凡茧形有数种。晚茧结成亚腰葫芦样，天露茧尖长如榧子形，又或圆扁如核桃形。又一种不忌泥涂叶者，名为贱蚕，得丝偏多。凡茧形亦有纯白、虎斑、纯黑、花纹数种，吐丝则同。今寒家有将早雄配晚雌者，幻出嘉种，一异也。野蚕自为茧，出青州、沂水等地，树老即自生。其丝为衣，能御雨及垢污。其蛾出即能飞，不传种纸上。他处亦有，但稀少耳。

抱 养

凡清明逝三日，蚕𧈧即不假衣衾暖气，自然生出。蚕室宜向东南，周围用纸糊风隙，上无棚板者宜顶格。值寒冷则用炭火于室内

【今译】

黄、白两种颜色，四川、陕西、山西、河南只有黄茧而无白茧，嘉兴、湖州有白茧而无黄茧。如将白茧蚕雄蛾和黄茧蚕雌蛾交配，则其后代结出褐色茧。黄色的丝用猪胰漂洗，也可变成白色，但始终不能染成青白和桃红二色。

蚕茧的形状也有好几种。晚蚕结成束腰像葫芦形的茧，天然露水浴过的蚕结成尖长像榧子形状的茧，或扁圆像核桃形的茧。还有种蚕不怕吃沾泥的桑叶，叫“贱蚕”，得丝反而多。蚕的皮色也有纯白、虎斑、纯黑、花纹数种，吐丝则相同。现在贫寒农家有将早蚕雄蛾与晚蚕雌蛾交配，而培育出良种，是令人惊奇的。柞蚕无须饲养而能自行结茧，出于青州、沂水等地，树叶枯黄时即自生蛾。用柞蚕丝做衣，能防雨及耐脏。其蛾钻出茧壳即能飞，不在纸上产卵传种。其他地方也有这种柞蚕，但很稀少。

蚕 的 饲 养

清明节过后三天，不必用衣被来保暖，幼蚕就会自然生出。蚕室宜面向东南，周围透风的缝隙用纸糊好，室内顶部无棚板的要加



produce any silkworms. Cocoons can be either yellow or white in color. There are only the yellow cocoons in Sichuan, Shanxi, Shaanxi and Henan provinces, while there are only the white cocoons in Jiaying and Huzhou prefectures. When a white male is crossed with a yellow female, their offspring, the cocoons will be light brown in color. Yellow silk can also be rinsed white with soap made from the fat of pigs, but they can never be dyed light blue or peach blossom-pink shades.

Cocoons have several shapes. The shape of the late cocoons are like a cucurbit, and the shape of silkworms bathed in dew is as slight as Chinese torrey seed, or as oblate as walnuts. There is also a kind of silkworm which can eat mulberry leaves with mud, named the humble silkworms. But this kind of silkworms produce more silk. The colors of the silkworms can be purely white, tiger stripes, pure black and spotted and so on. But they all produce silk in the same way. Nowadays, some poor farmers make male moths that hatch only once a year mate with female moths that can hatch twice a year, thus producing a better type, which is amazing. In such places as Qingzhou and Qishui there is a kind of wild silkworm which makes cocoons by themselves without being cared by human beings. When the tree leaves turn yellow, the moth flies away immediately upon emerging from the cocoon and its eggs are not preserved on paper sheets. Clothes made of the silk of tussah are waterproof and dirt-resistant. These kinds of wild silkworms are found elsewhere but are very rare.

Raising Silkworms

Three days after Pure Brightness, larvae will appear naturally without having to be kept warm by covering clothes or quilts. It will be much better if the silkworm rooms face southeast, with cracks in the



【原文】

助暖。凡初乳蚕，将桑叶切为细条，切叶不束稻麦稿为之，则不损刀。摘叶用瓮坛盛，不欲风吹枯悴。

二眠以前，腾筐方法皆用尖圆小竹筷提过。二眠以后则不用箸，而手指可拈矣。凡腾筐勤苦，皆视人工。急于腾者，厚叶与粪湿蒸，多致压死。凡眠齐时，皆吐丝而后眠。若腾过，须将旧叶些微拣净。若粘带丝缠叶在中，眠起之时，恐其即食一口则其病为胀死。三眠已过，若天气炎热，急宜搬出宽凉所，亦忌风吹。凡大眠后，计上叶十二餐方腾，太勤则丝糙。

养 忌

凡蚕畏香复畏臭。若焚骨灰、淘毛圉者顺风吹来，多致触死。隔壁煎鲍鱼、宿脂亦或触死。灶烧煤炭，炉熬沉檀亦触死。懒妇便器

【今译】

上顶棚。遇寒冷天则用炭火在室内取暖。喂幼蚕要将桑叶切成细条。切叶墩子用稻麦秆扎成，则不损坏刀口。摘下的桑叶用瓮坛盛放，不要让风吹干枯。

在蚕二眠以前，腾筐（除沙）都是用尖圆小竹筷将蚕提过去。二眠以后可不用筷，直接用手指拈了。腾筐是否勤，全在人工。腾筐不勤，则桑叶与蚕粪堆得较厚，又湿又热，常常会将蚕压死。蚕入眠时，都是先吐丝而后眠。如这时腾筐，须将旧叶拣得一干二净。如果有丝粘带的桑叶在里面，则眠起后的蚕哪怕只吃一口残叶，也会得病而胀死。三眠以后，如果天气炎热，应尽快将蚕搬到宽敞而凉爽的地方，但也怕风吹。大眠过后，要上十二次桑叶再腾筐，腾筐太勤则蚕丝粗糙。

饲养禁忌

蚕既怕香的气味，又怕臭的气味。如果有烧骨头或淘厕所的气味顺风吹来，触到蚕则往往造成死亡。隔壁煎咸鱼和不新鲜的油脂，也会使蚕致死。灶里烧煤炭、炉中点燃沉香、檀香，这些气味也会



wall pasted with paper and a ceiling added, if there is none. When the room is cold, heat it with a charcoal fire. When the larvae are fed, cut leaves into strips. The block used to cut leaves is made of wheat or straw stalks so that it won't damage the knife blade. Preserve mulberry leaves in earthen jars, lest they will be dried by the wind.

Before the second dormancy, the silkworm beds are cleaned. Pick up the silkworms with small round-pointed bamboo chopsticks when they are being changed from one basket to another. After the second dormancy, they can be moved by hand. The frequency of the basket changes depends on the silkworm farmers. If the silkworm beds are not cleaned frequently, mulberry leaves and excrement of the silkworm larvae will pile up, moist and hot, which will crush the silkworms to death. Silkworms produce silk before they fall asleep. If the beds are cleaned at this time, it is necessary to clean them thoroughly. If there are any old thick leaves and droppings, the silkworms will eat them after they wake up. Then even a little bite of them will make them sick and die of swelling. After the third dormancy, if it is hot, move the silkworms to a spacious and cool place as soon as possible. However, silkworms also can not stand wind. After the fourth dormancy, the bed should be cleaned after mulberry leaves are added twelve times. If it is overdone, silk will be coarse.

Avoidances

Silkworms can not bear either fragrance or stench. If odors of burning bones and the odor from the toilets come along with the wind, the silkworms will die easily. Odors of frying salted fish and stale grease will also cause silkworms to die. The scent of burning coal and Chinese eaglewood and *Lignum santalialbi* will also make silkworms



【原文】

摇动气侵，亦有损伤。若风则偏忌西南，西南风太劲，则有合箔皆僵者。凡臭气触来，急烧残桑叶，烟以抵之。

叶 料

凡桑叶无土不生。嘉、湖用枝条垂压，今年视桑树旁生条，用竹钩挂卧，逐渐近地面，至冬月则抛土压之。来春每节生根，则剪开他栽。其树精华皆聚叶上，不复生葇与开花矣。欲叶便剪摘，则树至七八尺即斩截当顶，叶则婆娑可扳伐，不必乘梯缘木也。其他用子种者，立夏桑葇紫熟时取来，用黄泥水搓洗，并水浇于地面，本秋即长尺余，来春移栽。倘浇粪勤劳，亦易长茂。但间有生葇与开花者，则叶最薄少耳。又有花桑，叶薄不堪用者，其树嫁接过，亦生厚叶也。

又有柘叶一种，以济桑叶之穷。柘叶浙中不经见，川中最多。寒

【今译】

使蚕致死。懒惰的妇女摇动装有粪便的便桶发出的臭味，对蚕也有损害。如果刮风，蚕只怕西南风，西南风吹得太猛，会全筐蚕都僵死的。遇有臭气袭来，要赶紧燃烧残桑叶，用烟来抵挡。

叶 料

桑树各处都可以种植。嘉兴、湖州用压条法繁殖，选当年桑树上长的侧枝用竹钩拉下来，使之逐渐接近地面，到冬天用土压住枝条。第二年春天每节都会生根，就可剪开分别移栽。用这种方法栽的桑树，精华都聚在叶上，不再结葇、开花了。要想使叶便于剪摘，则当树长至七八尺高时，斩截其树顶，树叶便披散下来，可扳枝摘取，不必登梯爬树。此外，用种子种的桑树，立夏时摘下熟得发紫的桑葇，用黄泥水搓洗，与水一块浇到地里，当年秋天就可长得一尺多高，来年春天再移栽。如果勤于浇粪，也容易长得茂盛。但也间有结葇、开花的，叶子则又薄又少。还有一种花桑，叶薄不能用，经过嫁接也能长出厚叶。

又有柘叶一种，用以接济桑叶之不足。柘树在浙江不常见，但



die. The scent of lazy housewives stirring the commode with urine and excrement will also do harm to silkworms. Silkworms are afraid of southwest wind. If the wind is too strong, a whole basket of silkworms will be stiffened to death. When there is any stench, burn discarded mulberry leaves quickly to fight against stench with the smoke.

Mulberry Leaves

Mulberry trees are grown everywhere. People in Jiaking and Huzhou prefectures plant mulberry trees by pressing the branches of the old trees into the ground. They choose lateral branches which grew out that year and pull them down with a bamboo hook close to the ground, and press them down with soil in winter. Each will grow roots the next spring and can be transplanted after being cut. The essence of mulberry trees planted by using this method is concentrated in the growing of leaves. They won't fructify and bloom. When trees grow to seven or eight *chi* high, their tops are cut off. The leaves will hang down and you can pick them without climbing ladders or trees. This is a convenient way to get leaves. What's more, mulberry trees can be planted by seeds. Pick seeds when they are purple and ripe, wash them with yellow mud water, pour them onto the ground with water. The seeds will grow into trees more than one *chi* high that autumn which can be transplanted the next spring. If watered and fertilized frequently, they are likely to flourish. But there are some which will fructify and bloom, thus their leaves will be sparse. There is also another kind of mulberry trees whose leaves are too thin to be eaten, but they can become thick after grafting.

There is a kind of leaf called three-bristle *cudrania*, which can take the place of mulberry leaves when they are in short supply. The



【原文】

家用浙种，桑叶穷时仍啖柘叶，则物理一也。凡琴弦、弓弦丝，用柘养蚕名曰棘茧，谓最坚韧。凡取叶必用剪，铁剪出嘉郡桐乡者最犀利，他乡未得其利。剪枝之法，再生条次月叶愈茂，取资既多，人工复便。凡再生叶条，仲夏以养晚蚕，则只摘叶而不剪条。二叶摘后，秋来三叶复茂，浙人听其经霜自落，片片扫拾，以饲绵羊，大获绒毡之利。

食 忌

凡蚕大眠以后，径食湿叶。雨天摘来者，任从铺地加餐。晴天摘来者，以水洒湿而饲之，则丝有光泽。未大眠时，雨天摘叶用绳悬挂透风檐下，时振其绳，待风吹干。若用手掌拍干，则叶焦而不滋润，他时丝亦枯色。凡食叶，眠前必令饱足而眠，眠起即迟半日上叶无妨也。雾天湿叶甚坏蚕，其晨有雾切勿摘叶。待雾收时，或晴

【今译】

四川最多。贫寒人家饲养浙江蚕种，在桑叶不够时，乃用柘叶充之，原理是一样的。琴弦、弓弦所用的丝，来自用柘叶养的蚕，名叫“棘茧”，据说其蚕丝最坚韧。采桑叶必须用剪刀，嘉兴府桐乡县所出产的铁剪最为锋利，别处的剪刀都比不过它。剪枝得法，当桑树再长出枝条后，第二个月就能长出很多叶。这样取得的桑叶又多，摘取也方便。再生枝条的叶，农历五月用以饲养晚蚕，则只是摘叶而不剪枝。第二茬叶子摘取后，到秋天第三茬叶子又茂盛起来，浙江人任其经霜自落，一片片地扫拾起来饲养绵羊，可大获羊毛绒毡的收益。

喂 食 禁 忌

蚕经大眠以后，就可直接吃湿的桑叶。雨天摘取的叶子，可随便摊开喂蚕。晴天摘取的叶，要以水洒湿后喂蚕，得到的丝就有光泽。蚕在未大眠时，雨天摘取的叶要用绳悬挂在透风的屋檐下，不时地振动绳子，让风吹干叶子。若用手掌拍干，则叶焦而不滋润，以后蚕吐出的丝也不光泽。喂叶时，蚕眠前必须令其饱足而后眠。眠起后，即使迟半日上叶也无妨。雾天的湿叶特别危害蚕，早晨有



three-bristle *cudrania* is rarely seen in Zhejiang Province while they are abundant in Sichuan Province. Poor families raise silkworms in Zhejiang Province; they feed silkworms with the three-bristle *cudrania* when the mulberry leaves are insufficient. The strings of the *qin* (a kind of musical instrument, similar to the lute) and the bow are made from silk produced by so-called *Ji* Silkworms which are fed with three-bristle *cudrania*, and the silk is said to be the most durable. Mulberry leaves are cut with shears, and the shears made in Tongxiang County of Jiaying Prefecture are the sharpest. No shears elsewhere can match them. With the right method of cutting, more leaves will appear in the second month after the mulberry trees grow new branches. Thus more mulberry leaves can be obtained easily. In May of the Chinese lunar calendar, feed late silkworms with leaves of new branches without cutting down its branches. The third stubble leaves will flourish in autumn after the second stubble is picked. People in Zhejiang Province will let the leaves fall naturally after they are stricken by frost and put them away to feed sheep. They will gain good benefits from the making of woolen materials.

Care in Feeding Silkworms

After the fourth dormancy, silkworms can eat wet leaves. Leaves picked on rainy days can be spread out casually to feed silkworms. Leaves picked on sunny days should be saturated with water, so the silk produced will be glossy. Leaves picked in rainy days should be hung on a rope under ventilated eaves. The rope should be shaken from time to time to dry the leaves. Such leaves can be used to feed the silkworms before they go into the fourth dormancy. If dried by clapping with hands, the leaves will be charred and the silk produced will be



【原文】

或雨，方剪伐也。露珠水亦待吁干而后剪摘。

病 症

凡蚕卵中受病，已详前款。出后湿热、积压，防忌在人。初眠腾时用漆盒者，不可盖掩逼出气水。凡蚕将病，则胸上放光，通身黄色，头渐大而尾渐小。并及眠之时，游定不眠，食叶又不多者，皆病作也。急择而去之，勿使败群。凡蚕强美者必眠叶面，压在下者或力弱或性情，作茧亦薄。其作茧不知收法，妄吐丝成阔窝者，乃蠢蚕，非懒蚕也。

物 害

凡害蚕者有雀、鼠、蚊三种。雀害不及茧，蚊害不及早蚕，鼠害则与之相终始。防驱之智，是不一法，唯人所行也。（雀屎粘叶，蚕食之立刻死烂。）

【今译】

雾时切勿摘叶。待雾散后，不论晴雨方可摘叶。有露水珠时，也要等晒干后再摘叶。

病 症

蚕卵所遇到的病害，前已述及。蚕从卵中孵出后遇到的湿热、积压，要靠人来防止。初眠腾筐时，用漆器作盖物的，要打开盖，以免捂出水气。蚕要生病时，胸部透亮，周身黄色，头渐大而尾渐小。而且该入眠时游走不眠，吃叶又不多，这都是病态。应当将其急速淘汰除去，勿使害群。健美的蚕必会眠在叶面上，压在下面的蚕不是体弱，便是懒惰，结茧亦薄。作茧不得法，胡乱吐丝结成松散的窝者，是蠢蚕而非懒蚕。

害 物

危害蚕的有麻雀、老鼠和蚊子三种害物。但麻雀害不到茧，蚊子害不到早蚕，而鼠害则自始至终存在。防除方法各种各样，因人施行。（麻雀屎粘到桑叶上，蚕食后立刻死烂。）



dim. Be sure the silkworms are full before they sleep. After dormancy, it is even all right to delay feeding them half a day. Wet leaves in foggy weather do great harm to silkworms, so don't pick leaves when it is foggy in the morning whether it is sunny or rainy. Wait until the fog disappears. When there is dew on leaves, please also wait until the leaves are dry.

Silkworm Diseases

The silkworm diseases have been mentioned above. When silkworms are hatched from eggs, attention should be paid to prevent them from moisture, heat or being pressed. When cleaning the beds at the time of their first dormancy, move the cover of lacquer away lest there will be any moisture in it. The symptoms of illness are as follows: the breast of the silkworm shines, the whole body is yellow, and their heads become bigger while tails become smaller gradually. What's more, they move about when they should sleep, and they eat less. Be sure to clear away such silkworms as soon as possible lest they will affect others. Good silkworms will sleep on leaves. Those that are below the leaves are either weak or lazy; the cocoons they produce will be thin. Those that spit out silk carelessly and form a loose cocoon without the right method are stupid silkworms rather than the lazy ones.

Enemies for the Silkworms

Three enemies do harm to silkworms: sparrows, mice and mosquitoes. Sparrows do not harm cocoons, mosquitoes do not harm the early silkworms but mice threat exists all the time. There are various ways to get rid of them adopted by different people. (Silkworms will die if they eat leaves with sparrows' dung on them.)



【原文】

老 足

凡蚕食叶足候，只争时刻。自卵出，多在辰巳二时，故老足结茧亦多辰、巳二时。老足者喉下两颊通明。捉时嫩一分则丝少，过老一分又吐去丝，茧壳必薄。捉者眼法高，一只不差方妙。黑色蚕不见身中透光，最难捉。

结 茧

凡结茧必如嘉、湖，方尽其法。他国不知用火烘，听蚕结出。甚至丛秆之内、箱匣之中，火不经，风不透。故所为屯、漳等绢，豫、蜀等绸，皆易朽烂。若嘉、湖产丝成衣，即入水浣濯百余度，其质尚存。其法析竹编箔，其下横架料木约六尺高，地下摆列炭，方圆去四五尺即列火一盆。初上山时，火分两略轻少，引他成绪，蚕恋火意，即时造茧，不复缘走。

【今译】

蚕的成熟

蚕吃足桑叶，要力争尽早捉蚕作茧，时间不可耽误。蚕卵孵化多在辰、巳这两个时辰，所以蚕发育成熟而结茧也多在这个时间。老熟的蚕喉下两颊透明。捉蚕时要是捉到未完全成熟的，吐丝就少。若是捉到过于老熟的，已吐一部分丝，其茧壳必薄。捉蚕的人眼法高明，捉得每只都恰到好处才妙。黑色蚕老熟时，不见其体内透明，最为难捉。

结 茧

结蚕茧时，必须按嘉兴、湖州采用的方法行事，才能达到完善的地步。其他地方不知用火烘，只听任蚕结茧。甚至让茧结到秆把上或箱匣里，既不用火烘，也不通风。因此，屯溪、漳州用这种丝织的绢和河南、四川的绸，都易于朽烂。要是用嘉兴、湖州产的丝做衣，即令在水中洗涤百次以上，丝质还是完好的。嘉兴、湖州的方法是劈竹编成竹席状的蚕箔，下面用木料搭架，离地面约六尺高，地面摆列着炭火，前后左右每隔四五尺即放一火盆。蚕初上山箔时，火力稍小些，引蚕吐丝，因为蚕喜欢温暖，便即时造茧，不再游走。



The Maturity of Silkworms

When silkworms have eaten enough leaves, it is necessary to pick them out to make cocoons as early as possible. Timing is important and can not be delayed. Silkworms usually hatch at *Chen* [7 to 9 a.m.] and *Si* [9 to 11 a.m.], so the silkworms become mature and form cocoons mostly at this time. Mature silkworms' cheeks below the throat are transparent. If those that are mature are picked out too soon, they will spit out little silk. If those that are too mature are picked out too late, they already spit out some silk and their cocoons are surely thin. Silkworm pickers should have keen eyesight to pick out the right ones at the right time. Black silkworms are the most difficult to pick since people can not see transparency in their bodies when they are mature.

The Spinning of Cocoons

For the spinning of cocoons, the method adopted by people in Jiaxing and Huzhou prefectures should be followed. People in other places don't know how to heat with fire, but just let silkworms make cocoons by themselves, and even allow cocoons to be formed on stalks and in cases without heating with fire and ventilating. As a result, spun silk made of such silk in Tunxi and Zhangzhou and silk in Henan and Sichuan provinces are likely to deteriorate. On the other hand, clothes made of silk produced in Jiaxing and Huzhou prefectures remain intact even if they are washed a hundred times. The way adopted in Jiaxing and Huzhou prefectures is as follow: split bamboo and weave it into the screen, support the screens with wooden shelves about six *chi* high below it, and place a basin with charcoal fire in it every four or five



【原文】

茧绪既成，即每盆加火半斤，吐出丝来随即干燥，所以经久不坏也。其茧室不宜楼板遮盖，下欲火而上欲风凉也。凡火顶上者，不以为种，取种宁用火偏者。其箔上山用麦稻稿斩齐，随手纠捩成山，顿插箔上。做山之人，最宜手健。箔竹稀疏，用短稿略铺洒，防蚕跌坠地下与火中也。

取 茧

凡茧造三日，则下箔而取之。其壳外浮丝一名丝匡者，湖郡老妇贱价买去（每斤百文），用铜钱坠打成线，织成湖绸。去浮之后，其茧必用大盘摊开架上，以听治丝、扩绵。若用厨箱掩盖，则沤郁而丝绪断绝矣。

择 茧

凡取丝必用圆正独蚕茧，则绪不乱。若双茧并四五蚕共为茧，择去取绵用。或以为丝，则粗甚。

【今译】

茧结成后，每盆火再加半斤炭，则吐出来的丝随即干燥，所以丝就能经久不坏。茧室不应当用楼板遮盖，因为结茧时下面要火烘，上面要通风。火盆顶上的茧不用作蚕种，取蚕种宁要用远离火盆的。蚕箔上的山簇用切齐的稻麦秆随手拧成，垂直插在蚕箔上。做山簇的人最好手力要大。蚕箔上的竹条稀疏时，可用短竹条略微补密，以防蚕掉到地上和火中。

取 茧

蚕结茧三天后，便取下蚕箔而取茧。茧壳外面的浮丝叫“丝匡”（茧衣），被湖州老妇以贱价买去（每斤百文），用铜钱坠作纺锤将其打成线，再织成湖绸。去掉浮丝后的茧，在大盘里摊开并放在架子上，以待缫丝和制丝绵。如用橱柜、箱子装蚕茧，会使其郁闷受潮，造成断丝。

择 茧

缫丝时必须用端正的独头茧，则丝绪不乱。若有两条蚕或四五条蚕共结的茧，要挑出来作丝绵用。如用这类茧缫丝，丝就会很粗。



chi. The fire should be kept moderate when silkworms are first placed on the screens. Because silkworms like warmth, they will produce silk immediately, and will not move around any more.

After silkworms make cocoons, add half a *jin* of charcoal into each basin, so as to make the silk spit out dry and last long. The cocoon room should not be covered since cocoons need heating below and ventilating above. Cocoons right above the basins cannot be used for silkworm eggs. Those far from the basin should be chosen. Bundles on the screen are screwed by hand with straw stalks and plugged into the screen vertically. People who make bundles should have strong hands. If the space of the screen is sparse, fill the space with some bamboo splints, so as to prevent silkworms from falling on the ground or falling into the fire.

Gathering Cocoons

Take down the screens and pick out the cocoons three days after they are formed. The silk outside of the cocoons is called *Sikuang* (loose silk or floss). Old housewives in Huzhou Prefecture buy it at a cheap price (a hundred of copper coins a *jin*). They use copper coins as spindle and make it into yarn and then weave it into the “spun-silk”. Spread cocoons without yarn on a big tray and put it on shelves for filature and making into silk floss. If placed in covered containers like cupboards or cases, the silk fibre will decay and break as a result.

Sorting Cocoons

Choose the regular single cocoons when silk is reeled, so the silk won't mingle. If there are twin cocoons or cocoons formed by four or five silkworms together, pick them out for making silk floss, otherwise the silk will be coarse.



山箔

Mature silkworms spinning cocoons on split-bamboo screens



治絲
Reeling silk fibers



【原文】

造 绵

凡双茧并缫丝锅底零余，并出种茧壳，皆绪断乱不可为丝，用以取绵。用稻灰水煮过（不宜石灰），倾入清水盆内。手大指去甲净尽，指头顶开四个，四四数足，用拳顶开又四四十六拳数，然后上小竹弓。此《庄子》所谓“泝泝统”也。

湖绵独白净清化者，总缘手法之妙。上弓之时，唯取快捷，带水扩开。若稍缓，水流去，则结块不尽解，而色不纯白矣。其治丝余者名锅底绵，装绵衣、衾内以御重寒，谓之挟纩。凡取绵人工，难于取丝八倍，竟日只得四两余。用此绵坠打线织湖绸者，价颇重。以绵线登花机者名曰花绵，价尤重。

【今译】

造 丝 绵

双宫茧和缫丝时留在锅底的碎丝断茧以及种茧壳，都是丝绪断乱而无法缫丝的，却可以造丝绵。将其用稻草灰水煮后（不宜用石灰），倾入清水盆内。将大拇指指甲修干净，用拇指顶开四个蚕茧，连续叠套在其余指头上，四个手指中每个手指都叠套四个蚕茧，用拳将茧顶开，这样每次用一只手的四指可顶开十六个蚕茧，然后用小竹弓敲打。这就是《庄子》所说的“泝泝统”吧。

湖州的丝绵特别洁白、纯净，是因为造绵的手法巧妙。上弓操作时贵在动作敏捷，带水将丝绵打开。如动作稍慢，水已流去，则丝绵结块而不能完全松开，看起来颜色也不纯白。缫丝剩下的东西叫锅底绵，将其装入绵衣被中用来御寒，称为“挟纩”。造丝绵所费的人工，八倍于缫丝，劳动一日每人只能得四两多丝绵。用这种丝绵坠打成线来织“湖绸”，价钱颇贵。用绵线在提花机上织出的产品叫“花绵”，价钱更贵。



Making Silk Floss

Double cocoons and remainders at the bottom of the pot after silk reeling can not be reeled into ordinary silk, but can be used to make silk floss. Boil them in rice straw ash water (lime water is not suitable), then pour them into a basin holding clear water. After clipping the thumb nail, the worker picks up a group of four cocoons at a time, and bores a hole at one side of each cocoon with the thumb. This operation is continued until four groups of fours (a total of sixteen cocoons) are treated. The opening of each cocoon is further enlarged by pressing through it by using the fist. These sixteen cocoons are then put under small bamboo bows for further stretching. This is what the Chinese philosopher Zhuangzi called “washing the spun silk”.

Silk floss produced in Huzhou is especially white and pure because of the superior techniques. When a cocoon is put under the bamboo bow, it must be knocked very quickly and deftly so it can be easily stretched while still in water. If the knocking is slow and the bowing is done when the water has already drained off, the silk fibre will be matted and cannot be loosened completely and it will not look pure white. The leftover filature is called “the pot-bottom silk”. It can be put inside the linings of garments and bedclothes to keep out the cold, both of which are called Xiakuang. Labor cost in making such silk floss is eight times that of silk reeling. One can only get a little more than four *liang* a day. People spin this kind of silk floss into thread and weave the thread into Huzhou silk, which is very expensive. Another type of silk product made with this silk is called “figured spun silk”, and is much more expensive.



【原文】

治 丝

凡治丝先制纰车，其尺寸、器具开载后图。锅煎极沸汤，丝粗细视投茧多寡。穷日之力，一人可取三十两。若包头丝，则只取二十两，以其苗长也。凡绫罗丝，一起投茧二十枚，包头丝只投十余枚。凡茧滚沸时，以竹签拨动水面，丝绪自见。提绪入手，引入竹针眼，先绕星丁头（以竹棍做成，如香筒样），然后由送丝竿钩挂，以登大关车。

断绝之时，寻绪丢上，不必绕接。其丝排匀、不堆积者，全在送丝竿与磨爪之上。川蜀纰车制稍异，其法架横锅上，引四五绪而上，两人对寻锅中绪，然终不若湖制之尽善也。凡供治丝薪，取极燥无烟湿者，则宝色不损。丝美之法有六字，一曰出口干，即结茧时用

【今译】

纰 丝

纰丝要先制纰车，其尺寸、部件都列在后面的插图中。纰丝时将锅内的水煮至极沸，将茧投入锅中。丝的粗细要看投茧多少，一人工作一天，可纰丝三十两。如果纰包头巾用的丝，只能得到二十两，因为这种丝比较细长。纰绫罗用的丝，一次投入锅内二十个茧，纰头巾用的丝只投十多个茧。当茧在锅内滚沸时，用竹签拨动水面，绪丝自会出现，用手牵住绪丝引入竹针眼，先绕过星丁头（用竹棍做成的像香筒形状的部件），然后将丝钩挂在送丝竿上，再接到大关车（脚踏转动的绕丝部件）上。

丝断时，找出绪头放上去，不必绕接原来的丝。使丝排列均匀而不堆在一起，全靠送丝竿和磨爪（带送丝竿的摇柄）的作用。四川纰车形式稍有不同，其方法是把纰车架在锅上，两人面对面地各自寻找锅中的绪丝，一次牵出四五根绪丝上车，但终究不如湖州纰车完善。纰丝用的薪柴，要干透而无烟湿之气的，这样才不致损害丝的色泽。使丝质美好的办法有六个字，一曰“出口干”，就是说在



Reeling Silk Fibres

A reeling machine must be made ready before silk is reeled. Its size and components are shown in the illustration in P165. Heat the water in a pot until it boils; pour the cocoons into the pot. The coarseness or fineness of the reeled thread depends on the number of cocoons put into the pot. One worker can get thirty *liang* of ordinary silk a day; one can get twenty *liang* of silk which is used to make scarfs, since the fibres for this purpose have to be longer. Put twenty cocoons in the pot at once if you want to get ordinary silk, and put a dozen if you want to get silk for scarfs. When the cocoons are being boiled in the pot, stir the surface of the water with bamboo sticks. By doing so the ends of the silk fibres are made visible. Take the ends by hand first and then pass them through the eyelets in the reeling machine. They are then placed over the pulley (made of bamboo cylinders) and fixed to the thread-passing rod and thence to be wound by the winch.

When one fibre breaks off during the mechanical process of reeling, find the loose end and put it in place. But there is no need to connect the two pieces together. The even distribution of the silk fibres on the machine is attributed to the skillful use of the pulley and the thread-passing rod. The use of the reeling machine in Sichuan Province is a little different. Here people put the reeling machine directly over the pot. Two men sit face to face and look for the fibre ends in the pot separately. They bring up four or five fibre ends to the reeling machine at a time. But it is not as good as the reeling machine in Huzhou Prefecture. Wood used for silk reeling should be extremely dry and smokeless when burnt, in order not to ruin the color of the silk. The way to make high-quality silk can be summed up by two phrases



【原文】

炭火烘。一曰出水干，则治丝登车时，用炭火四五两盆盛，去关车五寸许。运转如风时，转转火意照干，是曰出水干也。（若晴光又风色，则不用火。）

调 丝

凡丝议织时，最先用调。透光檐端宇下以木架铺地，置竹四根于上，名曰络筵。丝匡竹上，其旁倚柱高八尺处，钉具斜安小竹偃月挂钩。悬搭丝于钩内，手中执簠旋缠，以俟牵经、织纬之用。小竹坠石为活头，接断之时，扳之即下。

纬 络

凡丝既簠之后，以就经纬。经质用少，而纬质用多。每丝十两，经四纬六，此大略也。凡供纬簠，以水沃湿丝，摇车转锭而纺于竹

【今译】

结茧时用炭火烘。一曰“出水干”，就是说在缫丝上车时盆装四五两炭火，放在离大关车五寸之处，当关车飞速转动时，生丝借火温边转边干，此即出水干。（如天晴又有风，就不用火烘。）

绕 丝

即将织丝时，首先要绕丝。在光线好的屋檐下把木架铺在地上，木架上直插四根竹竿，名曰络筵。将丝围绕在竹上，络筵旁边的立柱上高八尺的地方，用铁钉钉上一根带有半月形挂钩的倾斜的小竹竿。将丝悬挂在半月形钩内，手中持簠（绕丝棒）旋转绕丝，以备牵经、织纬。小竹竿一端挂一小石块作为活头，断丝时一拉绳，挂钩就下来了。

卷 纬

丝在簠上绕好后，就可作经纬线了。经线用丝少，而纬线用丝多。每十两丝，经线用四两，纬线用六两，这是大致情况。供卷纬



in six Chinese characters. The first saying is “dry out of the mouth”: drying the silk with a charcoal fire as the cocoons are being spun by the silkworms. The second saying is “dry out of water”: as the silk is being wound onto the winch of the reeling machine, a small charcoal fire is made in a brazier and placed about five *cun* away from the winch. As the winch rotates and stirs the air nearby, the silk is dried in the heat as it passes through. This is called “dry out of water”. (If it is sunny and there is a gentle breeze, there is no need to heat with fire).

Spooling the Silk Fibres

Spooling the silk fibres is the first step toward the preparation of silk fibres for weaving. At a bright spot under the eaves, a skein frame is set up by fixing four bamboo sticks to a wooden board set on the ground. The reeled silk is stretched on the frame. At the point eight *chi* high on a pillar nearby, a device is set up which consists of a small, semicircular bamboo hook hanging at an angle, through which the silk fibres are passed. The ends of the fibres are attached to a hand spool which is held and rotated by the operator's hand, so that the silk is wound and ready to be converted into weft or warp yarn. If some fibre breaks off during the spooling process, the hook can be lowered by means of a lever that consists of a small bamboo rod with a suspended stone at its end to function as a weight.

Spinning Silk Fibres into Weft

After the silk fibres are spooled, the silk threads are made into warp and weft yarns by means of spinning. The warp yarn consumes less silk than the weft yarn. Generally speaking, in every ten *liang* of silk, warp takes four *liang* while weft takes six *liang*. The spools of silk fibres that



调丝

Spooling silk fibers



紡緯

The spinning wheel for making yarns



【原文】

管之上。

经 具

凡丝既簍之后，牵经就织。以直竹竿穿眼三十余，透过篾圈，名曰溜眼。竿横架柱上，丝从圈透过掌扇，然后绕缠经耙之上。度数既足，将印架捆卷。既捆，中以交竹二度，一上一下间丝，然后扱于笱内（此笱非织笱），扱笱之后，以的杠与印架相望，登开五七丈。或过糊者，就此过糊。或不过糊，就此卷于的杠，穿综就织。

过 糊

凡糊用面筋内小粉为质。纱、罗所必用，绫、绸或用或不用。其染纱不存素质者，用牛胶水为之，名曰清胶纱。糊浆承于笱上，推

【今译】

线用的簍，要将上面的丝用水湿润，再摇卷纬车带动锭子转动，把丝绕在竹管上。

牵 经 工 具

当丝线绕在簍上之后，便可牵经织丝。在一根直竹竿上穿三十多个小眼，眼内穿上竹圈，名曰溜眼。将这根竹竿横架在木柱子上，丝通过竹圈再穿过掌扇，然后缠绕在经耙之上。丝达到足够长度时，就卷在印架（卷经架）上。卷好后，中间用两根交竹把丝分一上一下，然后插于梳丝笱内（此笱不是织机上的笱）。穿过梳丝笱后，把的杠与印架相对拉开五至七丈远。需要浆丝的就此浆丝，不需浆丝的则就此卷在的杠上，即可穿综织丝了。

浆 丝

浆丝用的糊以面筋里面的淀粉为原料。织纱、罗必须要浆丝，织绫、绸可浆可不浆。用染过的丝织纱，因丝已失掉原来本性，要用牛胶水过浆，名曰清胶纱。浆料放在梳丝笱上，推移梳丝笱将丝



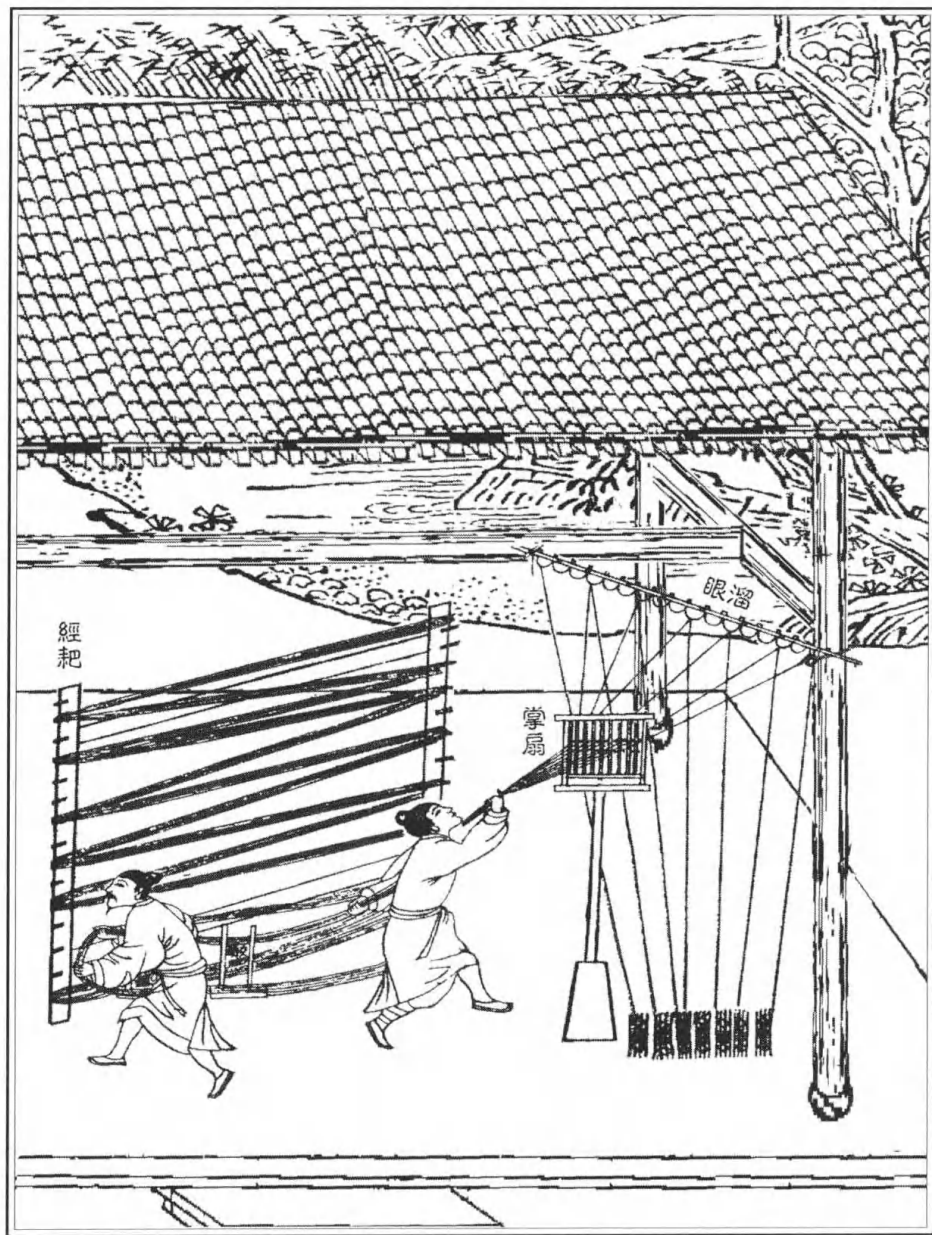
are intended for making weft yarn are first sprinkled with water, then twisted with a spinning wheel carrying a rotary ring, and finally spun onto a bamboo rod.

Warp Frame

After spooling, the silk threads are drawn into warp strands for weaving. A straight bamboo rod is pierced with thirty holes, each of which is connected with a split bamboo ring, known as “*Liuyan*”. The rod is held in a horizontal position by fixing its two ends separately on two supporting pillars. The silk thread of each spool is first drawn through a separate bamboo ring, then passed through one of the holes of a palm-shaped “Zhangshan (warp guiding-rake)”, and finally wound on a warp rack. When the silk is long enough, the silk threads are taken down from the rack and wrapped on the roll of a warp down into two groups by two pieces of bamboo. After that, the threads are first drawn through a combing harness (which is not the one used in weaving). When this is done, the beam is placed at a distance of fifty to seventy *chi* away from the roll from the warp frame. If the threads are to be sized, the sizing is carried out at this point; if this is not required, then the threads are rolled onto the warp beam and are ready for weaving.

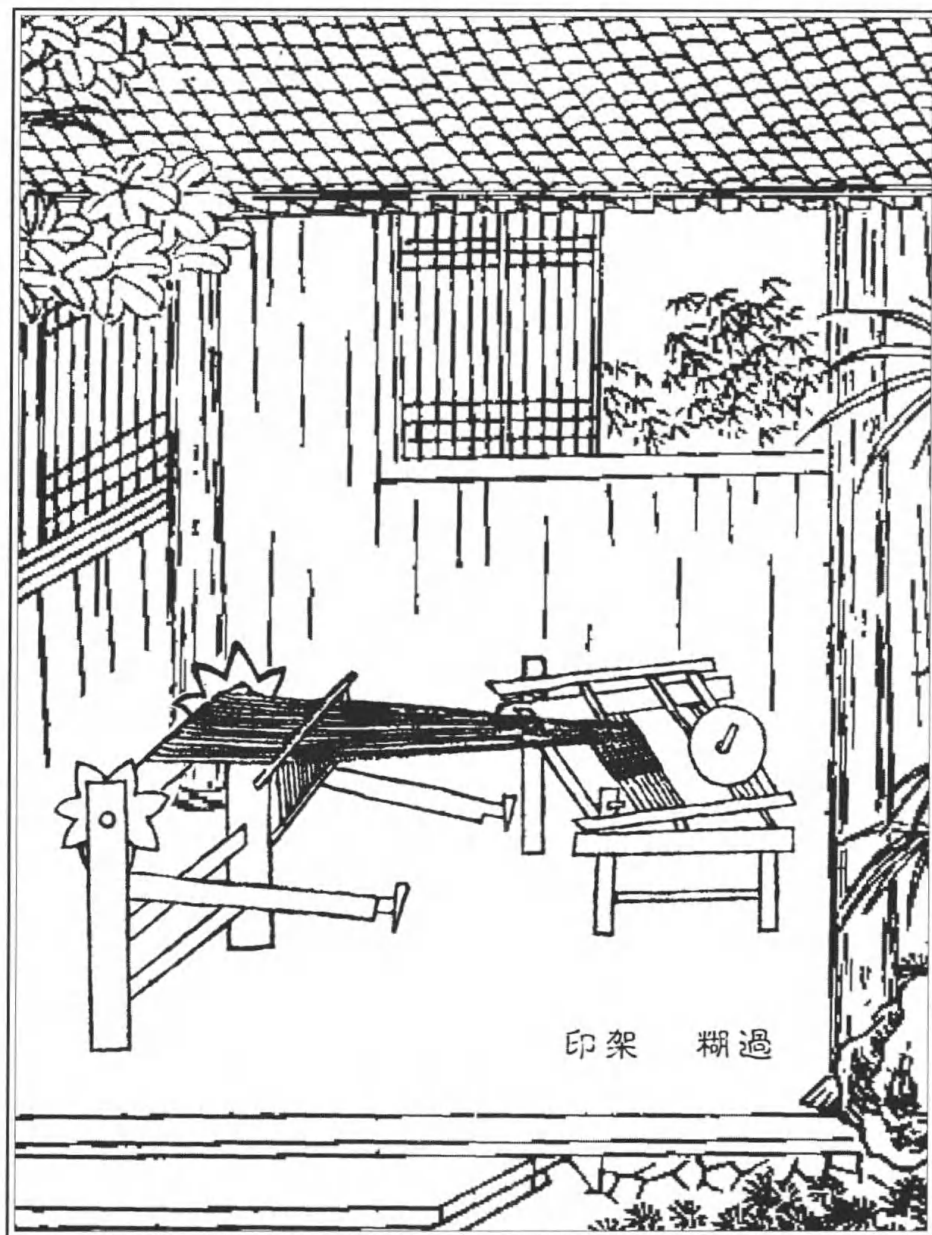
Sizing the Silk

The material commonly used for sizing is the starch from the gluten of wheat. Sizing is necessary for gauze (*luo*) and thin gauze (*sha*), but for damask and plain silk fabrics sizing is optional. If the thin gauze is to be dyed in colors so as not to show any of its natural hues, a solution of ox glue is used in sizing, and the product is called “thin-glue gauze”. The sizing liquid is held on top of the combing harness,



牵经

Drawing silk threads into warp strands



过糊 印架

The warped frame for separating and sizing warp threads



【原文】

移染透，推移就干。天气晴明，顷刻而燥，阴天必借风力之吹也。

边 维

凡帛不论绌、罗，皆别牵边，两旁各二十余缕。边缕必过糊，用笄推移梳干。凡绌、罗必三十丈、五六十丈一穿，以省穿接繁苦。每匹应截画墨于边丝之上，即知其丈尺之足。边丝不登的杠，别绕机梁之上。

经 数

凡织帛，罗、纱笄以八百齿为率，绌、绢笄以一千二百齿为率。每笄齿中度经过糊者，四缕合为二缕，罗、纱经计三千二百缕，绌、绢经计五千六千缕。古书八十缕为一升，今绌、绢厚者，古所谓六十升布也。凡织花纹必用嘉、湖出口、出水皆干丝为经，则任从提挈，不忧断接。他省者即勉强提花，潦草而已。

【今译】

浆透，随推随干。天气晴明，顷刻即干，阴天必须借风力吹干。

织 边

丝织物不论是厚的绌或薄的罗，纺织时都要另行织边。其两个边各牵经线二十余根，边经线必须过浆，用笄推移梳干。绌罗必三十丈或五六十丈穿一次笄，以省去穿接的繁苦。每织一匹（四丈）应在边经上用墨画记号，以掌握长度。织边的丝线不绕在的杠上，而是另外绕在织机横梁上。

经 线 数 目

织纱罗的笄以八百个齿为标准。织绌绢的笄以一千二百齿为标准。每个笄齿中穿入上浆的经线，四根合为二根。罗纱的经丝共三千二百根，绌绢的经丝共五六千根。古书称八十根为一升，现在较厚的绌绢就是古时所说的六十升布。织花纹时必须用嘉兴、湖州所产结茧和缫丝时都用火烘干的丝作经线，则任从提拉也不愁断头。其他省所出的丝，即使可勉强提花，也不精致。



which is moved back and forth through the silk threads in order to size and dry them. On a clear and sunny day the sized threads can be dried in a few minutes; but on cloudy days a breeze would be needed for drying.

The Border of Silk Fabrics

Whether the thick damask silk or the thin gauze, both need specially woven borders. There have to be over twenty threads on each side which must be dipped in liquid and dried by using moving hoops. Thread damask and gauze into hoop every thirty or fifty *zhang*, so as to reduce the times of warpings. Make a mark with ink on the sides every *pi* to control the length. The silk used for weaving the borders of silk fabrics is not wound on the yarn beam, but on the crossbeam of the loom.

The Number of Warp Threads

The harness used to weave yarn and gauze has eight hundred teeth, while that used to weave damask and thin silk has 1,200 teeth. Thread warp threads that have been sized onto each tooth and combine four threads into two warp yarns. Gauze and yarn have 3,200 warp threads while damask and silk have five or six thousand warp threads. In the books from ancient times, eighty warp threads is one *sheng*, the thick damask and thin silk nowadays is called cloth of sixty *sheng*. When weaving cloth with flower patterns, you must use silk produced in Jiaxing and Huzhou prefectures which is dried with heat into warp threads, which will not break off in the repeated lifting and shedding. Silk from other provinces might be used to make flower patterns, but using it will make inferior products.



【原文】

熟 练

凡帛织就犹是生丝，煮练方熟。练用稻稿灰入水煮。以猪胰脂陈宿一晚，入汤浣之，宝色烨然。或用乌梅者，宝色略减。凡早丝为经、晚丝为纬者，练熟之时每十两轻去三两。经、纬皆美好早丝，轻化只二两。练后日干张急，以大蚌壳磨使乖钝，通身极力刮过，以成宝色。

花 机 式

凡花机通身度长一丈六尺，隆起花楼，中托衢盘，下垂衢脚。（水磨竹棍为之，计一千八百根。）对花楼下掘坑二尺许，以藏衢脚。（地气湿者，架棚二尺代之。）提花小厮坐立花楼架木上。机末以的杠卷丝，中用叠助木两枝直穿二木，约四尺长，其尖插于筘两头。

叠助，织纱、罗者视织绦、绢者减轻十余斤方妙。其素罗不起花

【今译】

煮 丝

丝织物织成后仍是生丝，要经过煮练才成为熟丝。煮练的方法是先先将生丝用稻草灰加水煮，再加上猪胰脂陈放一晚，更在热水中洗涤，则色泽鲜明。如用乌梅水煮，色泽就差些。用早蚕的丝为经线并以晚蚕的丝为纬线而织成的丝，煮练后每十两会减轻三两。经纬线都用上好的早蚕的丝所织的，只减轻二两。煮练后晒干绷紧，再用磨光滑的大蚌壳用力将丝织物全面地刮磨一遍，使之显出光泽。

花 机 构 造

提花机通长一丈六尺，其高高隆起的部分是花楼，中间托着衢盘，下面垂吊着衢脚。（用加水磨光的竹棍做成，共一千八百根。）对着花楼的地下挖二尺深的坑，以容纳衢脚。（地下潮湿时，可架二尺高的棚代替地坑。）提花的徒工坐立在花楼的木架上。提花机末端以的杠卷丝，机的中部用两根叠助木来穿接两根约四尺长的木棍，棍尖插入织筘的两端。

织纱罗用的叠助木，比织绦绢的最好轻十几斤。织素罗不起花



Boiling

The silk in the woven cloth is still raw silk, which needs boiling to turn it into boiled silk. The method is to boil it in raw silk in rice straw ash water to remove the impurities and then steep it overnight in a solution of lard soap (soap made of pig fat). If washed in hot water, the silk will be bright; if washed in ebony water, it will look a little dull. Use the silk of early silkworms as warp and use the silk of late silkworms as weft and the product will be three *liang* lighter every ten *liang*. If people use the good silk of early silkworms as both the warp and weft, it will become two *liang* lighter. Dry it under the sun and tighten it, then polish it thoroughly with the smooth hull of the mussel to make it brighter.

Structure of a Draw-Loom

The draw-loom frame is one *zhang* and six *chi* in total length. The upper part is called *hualou* or “figure tower”. In the middle is the *qupan* or “drawer board”, and a *qujiao* or “rigid rod” (which is made of 1,800 water-polished bamboo rods to a loom) hangs below. Dig a pit about two *chi* deep under the “figure tower” to hold the rigid rod (when the ground is damp, a frame of two *chi* high can be built to replace the pit). The apprentice sits on the frame of *Hualou*. At the end of the draw-loom, the warp beam winds the silk, and two wooden poles in the center of the draw-loom connect two beams about four *chi* long, with the ends plugging into the two ends of the reed.

The shafts for weaving gauzes should be more than 10 *jīn* lighter than the one used for weaving damask and thin silk. There are no figure patterns on the silk called plain gauze. For weaving soft thin



【原文】

纹，与软纱、绫绢踏成浪梅小花者，视素罗只加桃两扇。一人踏织自成，不用提花之人闲住花楼，亦不设衢盘与衢脚也。其机式两接，前一接平安，自花楼向身一接斜倚低下尺许，则叠助力雄。若织包头细软，则另为均平不斜之机。坐处斗二脚，以其丝微细，防遏叠助之力也。

腰机式

凡织杭西、罗地等绢，轻素等绸，银条、巾帽等纱，不必用花机，只用小机。织匠以熟皮一方置坐下，其力全在腰尻之上，故名腰机。普天织葛、苎、棉布者，用此机法，布帛更整齐、坚泽，惜今传之犹未广也。

结花本

凡工匠结花本者，心计最精巧。画师先画何等花色于纸上，结本者以丝线随画量度，算计分寸秒忽而结成之。张悬花楼之上，即

【今译】

纹，要在软纱、绫绢上织出波浪、梅花等小花，比织素罗只多加两扇综框，一个人踏织即成，不用提花的人闲待在花楼上，亦不设衢盘与衢脚。其织机形式分为两段，前一段平放，从花楼向织工的一段向下倾斜一尺许，这样叠助木的冲力大些。若织包头巾之类细软的丝织物，则应另做一个水平而不倾斜的织机。人坐的地方安两个脚架，因织头巾的丝很细，要防止叠助木力猛。

腰机式

织杭西、罗地等绢，轻素等绸，以及银条、巾帽等纱，不必用提花机，只用小机。织匠用一块熟皮作靠背，其力全在腰和臀部，所以叫腰机。各地织葛、苎麻、棉布的，都用这种织机。织出的布、帛更整齐、结实而有光泽，可惜至今还没有普遍流传。

结花本

担任织花纹工序的工匠，心计最为精巧。画师先将某种花纹图案画在纸上，工匠能用丝线按照图样度量，精确算计得毫无差错而织结成纹样。花样悬挂在花楼上，即使织者不知会织成什么样的花纹，但



gauze or damask and pongee showing small, scattered designs, only two cross beams need to be added to the lighter loom used for weaving plain gauze. One weaver operating the loom with treadles is enough to finish the task; in this case no draw-boy is needed to man the “figure tower”, nor need the “drawer board” and “rigid rods” be set up. There are two parts of the weaving machine, with the front part lying level, the part from Hualou (figure tower) to weavers declining one *chi* or so. Thus increasing the force of the driving shafts. If weaving soft gauze to be used for scarves, a small loom of level surfaces should be used and the loom treadles are operated by the two feet of a seated weaver because the fine silk fibres for making scarfs may not withstand the force of the driving shafts.

The Structure of a Waist-loom

The draw-loom is not used when weaving silk fabrics like Hangxi and Luodi, light silk like Qingsu, or yarn like silver and scarf; a waist loom is used instead. Weavers use a piece of cured leather placed to support their waist. As the force comes from the waist and lower spine, it is therefore called a waist-loom. When used to weave hemp and cotton cloth, the products look stronger, cleaner and brighter. However, the practice has not become widespread.

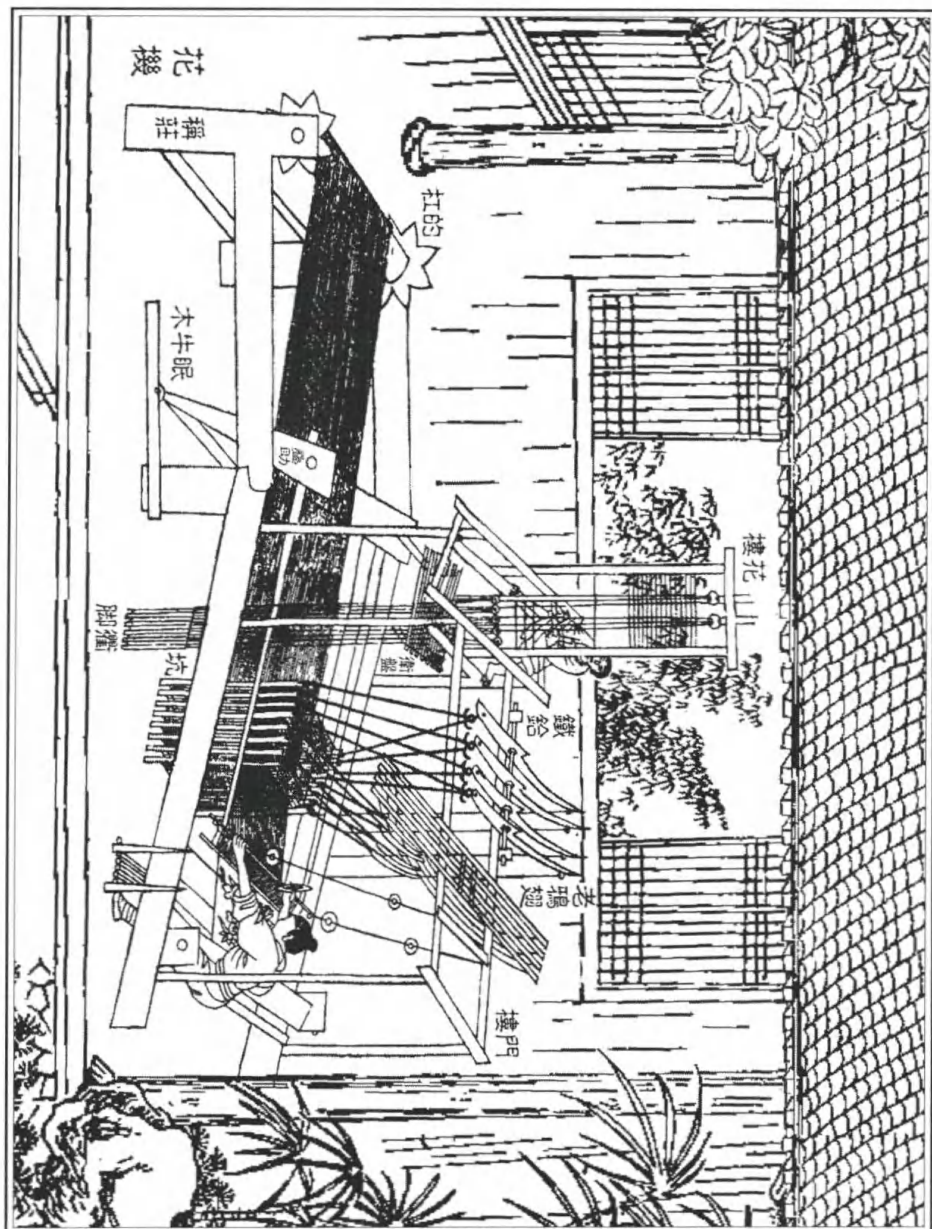
Making Figures according to Designs

The artisan who makes figure designs for weaving have to be clever. The artist first paints the pattern and color of a fabric design on a piece of paper, then the artisan exams the fabric design, then figures out how to make it without any mistake. Hang the design on the “figure tower” of the drawloom. Even if the artisan doesn’t know what the figure will



提花机

The draw-loom for figure-weaving





腰机

The waist-loom



【原文】

结者不知成何花色，穿综带经，随其尺寸、度数提起衢脚，梭过之后居然花现。盖绫绢以浮经而现花，纱罗以纠缠而现花。绫绢一梭一提，纱罗来梭提，往梭不提。天孙机杼，人巧备矣。

穿 经

凡丝穿综度经，必用四人列坐。过筘之人手执筘把先插，以待丝至。经过筘，则两指执定，足五七十筘，则绦结之。不乱之妙，消息全在交竹。即接断，就丝一扯即长数寸。打结之后，依还原度，此丝本质自具之妙也。

分 名

凡罗，中空小路以透风凉，其消息全在软综之中。袞头两扇打综，一软一硬。凡五梭、三梭之后，踏起软综，自然扭转诸经，空

【今译】

穿综带经，按照纹样尺寸度数，提起衢脚，穿梭织造后，花样居然会显现出来。因为绫绢以浮起经线而显花纹，纱罗是纠集纬线而显现花纹。因此织绫绢是一梭一提，织纱罗是来梭时提花，回梭时不提。天上织女的纺织技术，人间的巧手均已掌握。

经线穿综和织筘

将经线穿过综和织筘，需要四个人并坐着操作。穿织筘的人手持筘把先插入筘中，等待另一人将丝递过来。丝过筘后，用两指握住，穿好五十至七十筘后把丝扭结起来。丝之所以不乱的奥妙，机能在乎可将丝上下分开的“交竹”。接断丝时，将丝一拉就能拉长几寸。打好结后又缩到原来长度。这是丝自身所具有的妙用。

丝织物种类

罗之类的丝织物有中空的小孔以透风取凉，其织造的关键在于用线绳做成的软综（绞综）。用两扇袞头打综，一个是软综，一个是硬综。织过五梭、三梭（最厚的七梭）纬线之后，踏起软综，自然会使



look like, but follow the design and the figure will appear at last. The appearance of the figure in damask and thin silk depends on warp, while the appearance of figure of yarn and gauze depends on weft. In the weaving of damasks and pongees, the warp is lifted at every pick of the shuttle, but in the case of gauzes it is lifted only at every other pick. The weaving skills of Vega in heaven have been mastered by skillful artisans here in the country.

Warping

It takes four persons sitting alongside to pass each warp thread or yarn through separate heddle-eye of the weaving harness. The man who passes the warp threads through the heddle-eyes holds the harness frame and waits for another person to pass silk to him. When the warp threads have been passed through the harness, they are held with two fingers until fifty to seventy warp threads are gathered. Then they are tied together. The secret of the tidiness of silk lies in the use of a bamboo rod which separates silk. When a thread breaks, it only needs pulling out several *cun* longer, and it will go back to the former length after connection. This is the advantage of silk.

Names of Silk Fabrics

Silk fabrics like *luo* or gauze have little holes in it to let in the air for the sake of coolness. The key to this weaving lies in the "soft" harnesses made of strings. The loom has two harnesses, one is soft and the other is hard and each harness is operated by a cam-type level. After the shuttle is passed three or five times, the two sets of warp yarns are individually twisted together by raising the soft harness. The key to weaving yarn also lies in the two cams. Remove the two cams



【原文】

路不粘。若平过不空路而仍稀者曰纱，消息亦在两扇袞头之上。直至织花绫绸，则去此两扇，而用桃综八扇。

凡左右手各用一梭交互织者，曰绉纱。凡单经曰罗地，双经曰绢地，五经曰绫地。凡花分实地与绫地，绫地者光，实地者暗。先染丝而后织者曰缎（北地屯绢亦先染过）。就丝绸机上织时，两梭轻、一梭重，空出稀路者，名曰秋罗，此法亦起近代。凡吴越秋罗，闽广怀素，皆利缙绅当暑服，屯绢则为外官、卑官逊别锦绣用也。

龙袍

凡上供龙袍，我朝局在苏杭。其花楼高一丈五尺，能手两人扳提花本，织过数寸即换龙形。各房斗合，不出一手。赭、黄亦先染

【今译】

两股经丝绞组成绞纱孔，而不并合起来，形成网眼。如果一直织下去，不起条纹而普遍有孔的，就叫纱，织纱的关键也在两扇袞头。直到织花绫绸时，才去掉两扇袞头，而用八扇桃综。

左右手各用一梭交互织成的叫绉纱。经线单起单落织出的叫罗地，用经线双起双落织出的叫绢地，经线每隔四根提起一根织成的织物叫绫地。提花织物分为平纹实地（素地）与斜纹绫地（花地），绫地光亮，实地较暗。先染丝而后织成质地较厚密的织物叫缎（北方的屯绢也是先染丝）。丝在织机上如织两梭平纹、一梭起绞综，形成一排排纱孔的，叫做秋罗，这种织法也起于近代。江苏、浙江的秋罗，福建、广东的熟罗，都是供官绅作夏服用的，而屯绢则为地方小官用作锦绣的代用品衣料。

龙袍

供皇帝用的龙袍，我朝的织造局设在苏州和杭州。生产龙袍的织机的花楼高达一丈五尺，由两名技术能手拿着设计好的花样提花，每织过几寸之后，便变换提织龙形图案的另一部分。龙袍由机房各



and use eight cross beams in weaving figured damask and pongee.

Change the shuttle from hand to hand and you will get a kind of yarn called crepe. With a single warp going up and down, you will get *loudi*; two warps going up and down together, you will get *juandi*; while if you pick up one warp every four warps, you will get *lingdi*. Silk fabrics with figures can be divided into plain-weave, which is dark, and damask-weave, which is bright. Thick silk fabrics made by dyeing first are called satin. (The plain pongee in North China is also made in the same way.) Weave two shuttles of plain-weave and then one shuttle of soft harness, then lines of holes will appear; this kind of silk is called *qiuluo*. This kind of weaving dates from recent times. *Qiuluo* in Jiangsu and Zhejiang provinces and *shuluo* in Fujian and Guangdong Provinces are used to make costumes for high-ranking officials to wear in summer, while the plain pongee is used to make clothes for provincial officials of lower status.

Dragon Robes

Emperors wear dragon robes. The factories producing dragon robes in the Ming Dynasty are located in Suzhou and Hangzhou. The *hualou* used to produce dragon robes is one *zhang* and five *chi* high. Two skillful weavers weave them according to the prepared figure design and the shape of the woven dragon changes after every few *cun* of weave. Dragon robes are not finished by a single person. The work is divided into several parts which are finished by different departments of the factory and combined together. The silk is dyed red and yellow;



【原文】

丝，工器原无殊异，但人工慎重与资本皆数十倍，以效忠敬之谊。其中节目微细，不可得而详考云。

倭 缎

凡倭缎制起东夷，漳、泉海滨效法为之。丝质来自川蜀，商人万里贩来，以易胡椒归里。其织法亦自夷国传来。盖质已先染，而斫线夹藏经面，织过数寸即刮成黑光。北虏互市者见而悦之。但其帛最易朽污，冠弁之上顷刻集灰，衣领之间移日损坏。今华夷皆贱之，将来为弃物，织法可不传云。

布 衣

凡棉衣御寒，贵贱同之。棉花古书名臬麻，种遍天下。种有木棉、草棉两者，花有白、紫二色。种者白居十九，紫居十一。凡棉春

【今译】

部分工织造单独部分再拼合而成，不是出于一人之手。所用的丝先染成红、黄等色，所用工具没有什么特别之处，只是人工和成本要增加数十倍，以表示忠敬之意。其中细节繁多，不可详考。

倭 缎

倭缎制法起自日本国，福建漳州、泉州沿海地区曾加以仿制。其丝的原料来自四川，由商人万里贩来，交换胡椒而归。其织法亦自日本国传来，先将丝料染色作为纬线，再将剪断的铜线夹织到经线中，织过数寸经丝后将织物刮成黑光。东北满族地区的商人见到这种织物很是喜欢。但因其最易污损，做成的帽子戴上后很快积聚灰尘，做成衣领穿不了几天就损坏。现在各地都不看重，将来或许被淘汰，其织法也未必会流传下去。

棉 布

用棉衣御寒，不分贵贱。棉花在古书中叫臬麻，各地都种植。有木棉、草棉两种，花有白、紫两色。种白棉的占十分之九，紫棉占



the weaving equipment is the same as that used in ordinary weaving, but the manpower and cost will be scores of times more than those spent on common silk clothes. The subjects do so to show their respect to the emperors. It is difficult to know the minute details in the weaving of these robes.

Satin

The knowledge for making satin comes from Japan and has spread to China's coastal areas like Zhangzhou and Quanzhou in Fujian Province. The raw materials for the silk come from Sichuan Province and are brought by merchants far away to exchange for pepper. The method for weaving this kind of satin also came from Japan. Dye silk first and use it as weft, then cut off copper wires and weave between warps; weave several *cun* of warp and scrape the fabric black. The Merchurian merchants in northeastern China like this fabric very much. However, because it gets stained easily, hats made of it collect dust quickly, and the collars of clothes made of it are worn out within several days. As a result, it is not popular nowadays. Since it is popular now and it is likely to become unwanted in the future there is no need to write down the method of weaving this satin.

Cotton Fabrics

People, noble or humble, all wear cotton clothing to keep warm in winter. In ancient books cotton is called male hemp and is planted everywhere. There are two species, tree cotton and cotton plant, whose flowers are either, white or purple. Ninety percent of the people plant white-flower cotton while ten percent of the people plant purple-flower cotton. Cotton is planted in the spring and it fructifies in the autumn. Cotton is not picked at the same time. As they are picked when each



【原文】

种秋花，花先绽者逐日摘取，取不一时。其花粘子于腹，登赶车而分之。去子取花，悬弓弹化。（为挟纆温衾、袄者，就此止功。）弹后以木板擦成长条以登纺车，引绪纠成纱缕。然后绕簾、牵经就织。凡纺工能者一手握三管纺于锭上（捷则不坚）。

凡棉布寸土皆有，而织造尚松江，浆染尚芜湖。凡布缕紧则坚，缓则脆。碾石取江北性冷质膩者（每块佳者值十余金），石不发烧，则缕紧不松泛。芜湖巨店首尚佳石。广南为布藪，而偏取远产，必有所试矣。为衣敝浣，犹尚寒砧捣声，其义亦犹是也。外国朝鲜造法相同，唯西洋则未核其质，并不得其机织之妙。凡织布有云花、斜

【今译】

十分之一。棉花在春天播种，秋天结花，棉桃先裂开的逐天摘取，不是在同同时摘取。棉花絮与棉子粘在棉桃内，需要用轧花、脱子的赶车才能将二者分开。棉花去子后用弹弓弹松。（做棉被、棉衣的棉花，就加工到这一步而止。）弹后在木板上将棉花搓成长条，再在纺车上牵引棉绪纺成棉纱。然后将棉纱绕到簾上，就可牵经织布了。纺织能手一人手握三个纺锤，把三根棉纱纺在锭子上（纺得太快则棉纱不坚）。

棉布各地都生产，但织造技术以松江为最高，浆染以芜湖为最高。棉纱纺得紧密，布就结实，纺得松，布就不结实。浆染布时用的碾石采用江北所产性冷而质细的石料（每块好的碾石值十两银子），用这种碾石碾布时不易发热，而且纱线紧密而不松散。芜湖的大染店特别注重用好的碾石。广南是棉布的集中地，却偏偏用远处产的碾石，一定是经过试验后才这样做的。衣服穿旧时浆洗，也习惯在性



ball matures and splits open, they are picked day by day. Cotton wadding and cotton seeds are inside the cotton bolls, which must be separated by a cotton gin. Bow the clean cotton fibres after the removal of the seeds. (Cotton at this stage is good for making quilts and clothes). Twist cotton that is on the board into long strips and weave these strips into cotton yarns with the hand-operated spinning wheel. The resultant warp yarns are wrapped on the loom beam and then interlaced with the weft yarns to make fabrics. Master-hands hold three spindles, and weave yarn onto them. (The cotton yarn which is made too fast is not strong.)

Cotton fabrics are produced everywhere in the country; however, the weaving skill in Songjiang Prefecture, and the sizing and dyeing in Wuhu are the best. The tightly woven fabric is strong and long-lasting, but it breaks easily when it is loosely woven. The best stone rollers used in sizing and dyeing come from cold and delicate textured stone in the north of the Yangtze River. (One piece of high-grade stone costs ten *liang* of silver.) In the process of calendering, the stones will not get hot and the tightly woven fabrics will not become loose. The dyeing houses in Wuhu use good stone rollers. Guangdong is the home of cotton cloth, but they use stone rollers from faraway places. They must have good reasons. When clothes need sizing, also thump them on such good stones. The weaving method in Korea is the same as that in China, but raw materials for cloth in the west are not clear, nor is the weaving method. The patterns used for the figure-weaving of cotton fabrics are “cloud”, “twill”, “elephant eye” and so on. These patterns are modeled on those used in the weaving of silk fabrics by the draw-loom. However, since the fabric is only made of cotton, a plain un-figured weave would be good enough. It is not necessary to give illustrations of



赶棉

The cotton gin for separating fibres from seeds



彈棉
Bowling of cotton fibres



擦条

Straightening and rolling bowed cotton fibers



紡縷

The hand-operated spinning wheel



【原文】

纹、象眼等，皆纺花机而生义。然既曰布衣，太素足矣。织机十室必有，不必具图。

臬 著

凡衣衾挟纩御寒，百人之中，只一人用茧绵，余皆臬著。古缁袍，今俗名胖袄。棉花既弹化，相衣衾格式而入装之。新装者附体轻暖，经年板紧，暖气渐无，取出弹化而重装之，其暖如故。

夏 服

凡苧麻无土不生。其种植有撒子、分头两法。（池郡每岁以草粪压头，其根随土而高，广南青麻撒子种田茂甚。）色有青、黄两样。每岁有两刈者、有三刈者，绩为当暑衣裳、帷帐。凡苧皮剥取后，喜日燥干，

【今译】

冷的石板上捶打，其道理也是一样的。外国朝鲜织布方法也与中国一样，只有西洋布没有查明其原料，也不知其机织技术。棉布可织出云花、斜纹、象眼等花纹，都是仿照花机原理而制成。但既然称为布衣，织成平纹也就够了。十户人家中必有织机，不必附图于此。

棉 衣

以棉衣、棉被御寒的，百人之中只有一人在其中装入丝绵，其余都用棉花。古时的缁袍今俗称为胖袄。棉花弹好后，便依据衣服、被子的形状将棉花放进去。新做的棉衣穿在身上显得轻暖，但穿得久就会板紧，逐渐不保暖。将其中棉花取出弹松，再重新装入衣内，仍像原来一样暖和。

夏 服

苧麻到处都可以生长。其种植有播种和分根两种方法。（池州每年将草粪压在根部，麻根顺着压土而长高。广南的青麻以种子撒在田地，长得颇茂盛。）苧麻有青、黄两种颜色。每年有收割两次、三次的，织成夏天用的衣服和帷帐。苧麻剥皮后，最好在阳光下晒干，否则见水就



the loom for weaving cotton fabrics, because the loom is to be found in every ten families.

Cotton Padding

Almost all people use cotton to make cotton-padded coats and quilts to keep warm with an exception of one person out of a hundred who uses silk floss. After bowing the cotton, stuff it into the clothes or quilts according to their shapes. Newly-made clothes are light and warm to wear, but they will become hard and not so warm as time goes by. Take out the cotton and bow again the clothes and refill them again, the clothes will be as warm as the newly-made ones.

Summer Clothing

Ramie, known as *chuma* in China, is grown everywhere. There are two ways of planting, sowing the seeds and burying root cuttings. (Every year people in Chizhou cover the roots of ramie with a mixture of grass and manure. The roots will grow to the height of the manure covering. People in Guangdong Province grow piemarker by planting seeds in the field where it will flourish). Ramie is of two colors, green and yellow. Ramie can be harvested two or three times, and made into clothes to wear in summer as well as drapery. The ramie after being reeled had better be put out in the sun and dried; otherwise it will rot when it meets water. Dip ramie in water after tearing off its outer covering. But be sure to dip just for twenty quarters, that is to say, five hours, or it will become rotten if dipped too long. The color of ramie is light yellow and will become white after being bleached. (Ramie is first boiled in rice straw ash water or lime water and



【原文】

见水即烂。破析时则以水浸之，然只耐二十刻，久而不析亦烂。苧质本淡黄，漂工化成至白色。（先取稻灰、石灰水煮过，入长流水再漂，再晒，以成至白。）纺苧纱，能者用脚车，一女工并敌三工。唯破析时穷日之力只得三五铢重。织苧机具与织棉者同。凡布衣缝线、革履串绳，其质必用苧纠合。

凡葛蔓生，质长于苧数尺。破析至细者，成布贵重。又有苘麻一种，成布甚粗，最粗者以充丧服。即苧布有极粗者，漆家以盛布灰，大内以充火炬。又有蕉纱，乃闽中取芭蕉皮析、绩为之，轻细之甚，值贱而质朽，不可为衣也。

裘

凡取兽皮制服，统名曰裘。贵至貂、狐，贱至羊、鹿，值分百等。貂产辽东外徼建州地及朝鲜国。其鼠好食松子，夷人夜伺树下，

【今译】

烂。将麻皮撕破时要用水浸泡，但只能浸二十刻（五小时），浸久时不撕也要烂。苧麻本是淡黄色的，经过漂洗才成为白色。（先用稻草灰水或石灰水煮过，再在流动的水中漂洗，晒干后就成了白色。）纺苧纱的能手用脚踏纺车，一女工可抵三人。但撕裂麻皮则一日只得三五铢重纤维。织苧麻的机具与织棉相同。缝布衣的线和作皮鞋的串绳，都用苧麻搓成。

葛是蔓生的，其纤维比苧麻长数尺。用破析得很细的葛纤维织布，十分贵重。还有一种苘麻，织成布较粗，最粗的布用作丧服。即使是苧布，也有很粗的，漆工用以蘸灰擦磨漆器，而宫内则用以作火把。还有一种蕉纱，是福建地区取芭蕉的韧皮破析、纺织而成，轻细之甚，不值钱也不结实，不堪做衣服。

皮衣

凡用兽皮做的衣服统名之为裘。贵重的有貂皮、狐皮，便宜的有羊皮、鹿皮，价格的等级有百种之多。貂产于辽东塞外的建州地区及朝鲜国。貂鼠喜欢吃松子，满族地区的猎人晚间悄悄地藏在松



then it is rinsed in flowing water; it turns white when it is dried in the sun). Skillful workers operate weaving machines with their feet for spinning ramie yarns. In this way a female worker can produce in one day as much yarn as that produced by three workers who do the work with hand spindles. However, one can only reel and get four or five *zhu* of fibre. The machine used to weave ramie is the same as that for weaving cotton. Threads used to sew clothes and make leather shoes are all made of ramie.

There is a similar species called Ge plant, a creeper plant, whose fibres are several *chi* longer than those of the ramie. Cloth made of the tiny fibre of this plant is expensive. There is still another kind called *qingma* (piemarker), the cloth made of which is coarse; the coarsest is used to make mourning dresses. Cloth made of ramie can be coarse, too. Painters usually dip it in ash and polish lacquer work while it is used for torches in palaces. There is also another kind, called *Jiao* yarn which is made from the skin of plantains. It is so tiny that it is not strong enough to make clothes and thus is not valuable.

Furs

All clothes made of furs are called fur coats. Their prices are different, from the expensive clothes made of sable furs and fox furs to cheap clothes made of sheepskin and deerskin. Sables are found in Jianzhou area, north of the Great Wall in Liaodong and in Korea as well. They are fond of pine nuts. The native hunters, in the area where the Manchurians live, await secretly under pine trees in order to shoot sables at night. The skin of one sable's fur is less than one square *chi* in size, so that over sixty sableskins can only make one fur coat or



【原文】

屏息悄声而射取之。一貂之皮方不盈尺，积六十余貂仅成一裘。服貂裘者立风雪中，更暖于宇下。眯入目中，拭之即出，所以贵也。色有三种，一白者曰银貂，一纯黑，一暗黄。（黑而长毛者，近值一帽套已五十金。）凡狐、貉亦产燕、齐、辽、汴诸道。纯白狐腋裘价与貂相仿，黄褐狐裘值貂五分之一，御寒温体功用次于貂。凡关外狐，取毛见底青黑，中国者吹开见白色，以此分优劣。

羊皮裘，母贱子贵。在腹者名曰胞羔（毛文略具），初生者名曰乳羔（皮上毛似耳环脚），三月者曰跑羔，七月者曰走羔（毛文渐直）。胞羔、乳羔为裘不膻。古者羔裘为大夫之服，今西北缙绅亦贵重之。其老大羊皮硝熟为裘，裘质痴重，则贱者之服耳。然此皆绵羊所为。

【今译】

树下伺机射取。一张貂皮不到一尺见方，积六十多张貂皮仅成一件皮衣。穿貂皮衣的人站在风雪之中，比在室内还觉得暖和。灰沙眯眼时用貂皮一擦即出。此其所以贵重的原因。貂皮有三种颜色，一种色白的叫银貂，一种是纯黑色，另一种是暗黄色。（近来一顶黑色长毛的貂皮帽值五十两银子。）狐和貉也产于北方的河北、山东、辽宁、河南等地。纯白的狐腋皮衣与貂皮衣相仿。黄褐色的狐皮衣价值为貂皮衣的五分之一，御寒暖体的功用次于貂皮。关外狐皮拨开毛见皮板是青黑色，内地的吹开毛露出白色皮板，用这种方法区分优劣。

羊皮衣中老羊皮贱而羊羔皮贵。怀在腹中的羊羔叫胞羔（刚刚长毛），刚出生的叫乳羔（皮上的毛像耳环钩，弯弯曲曲的），长三个月后的叫跑羔，长七个月叫走羔（皮上的毛渐渐变直）。用胞羔、乳羔的皮做衣没有膻味。古时羔皮衣为大夫之服，现在西北的官绅也很看重它。老羊皮经过硝熟之后做衣，穿起来显得笨重，是下层人的衣服。



garment. Wearing such clothes outside in a snowy and windy day, one feels as warm as staying indoors. If dust or sand gets into your eyes, you can remove it quickly by using the sable. This is the reason why it is very expensive. Sable furs are of three colors: one is white, called silver sable; another is net black; and the third is dark yellow. (Recently, a hat made of long-haired black sable costs fifty *liang* of silver.) Foxes and badgers also live in Hebei, Shandong, Liaoning, Henan and other places in northern China. Pure white coats made of the fox's underarm fur are almost as expensive as those made from sable. A brown fox fur coat costs one fifth that of the sable, but it is warmer than the coat made of sables. The fox's skin in northern China beyond Shanhaiguan (which is the dividing line between the northeastern part of the country and the rest of the island areas) is black, while the fox's skin inland is white. This method can be used to tell the superior fur from the inferior fur.

Coats made of the skin of the mother sheep are a little cheaper than those made of the lamb. An unborn lamb (which has just grown hair) is called an "unborn sheep"; a lamb that is just born is called "baby lamb" (with its hair as curly as the ends of earrings). A three-month-old lamb is called "running sheep", while a seven-month-old lamb is called "walking lamb" (Their hair gradually becomes straight). Coats made of the skins of cell sheep and baby sheep don't have a sheep odor. In ancient times, the skins of baby sheep were used to make clothes for officials. Nowadays even officials in northwestern China like them, too. The skins of old sheep are cured and made into heavy coats or garments that are worn by the lower classes; however, they are all made of the skins of sheep. The skins of sheep in the south are as thin as paper after the removal of hair and treatment in Glauber's salt. These skins can only



【原文】

若南方短毛革，硝其鞣如纸薄，只供画灯之用而已。服羊裘者，腥膻之气习久而俱化，南方不习者不堪也。然寒凉渐杀，亦无所用之。

麂皮去毛，硝熟为袄裤，御风便体，袜靴更佳。此物广南繁生外，中土则积集楚中，望华山为市皮之所。麂皮且御蝎患，北人制衣而外，割条以缘衾边，则蝎自远去。虎豹至文，将军用以彰身。犬、豕至贱，役夫用以适足。西戎尚獭皮，以为毳衣领饰。襄黄之人穷山越国射取而远货，得重价焉。殊方异物如金丝猿，上用为帽套。扯里猻，御服以为袍，皆非中华物也。兽皮衣人，此其大略，方物则不可殚述。飞禽之中有取鹰腹、雁胁毳毛，杀生盈万，乃得一裘，名天鹅绒者，将焉用之？

【今译】

然而这些皮衣都是绵羊皮做成的。南方的短毛羊皮，其去毛的皮在硝熟之后薄得像纸，只能用来做画灯而已。穿羊皮衣的人，对腥膻之气日久便习惯而无所谓了，但南方不习惯于此味的人便受不了。不过往南气候渐暖，皮衣也就派不上用场了。

麂皮去毛用芒硝鞣制后做成袄裤，穿起来遮风蔽体，做成鞋袜更好。这种动物除繁生于广南外，中原地区集中于湖南、湖北，望华山是毛皮交易的场所。麂皮还能防止蝎患，北方人除做衣之外，还剪成长条镶被边，这样蝎子就不能接近。虎、豹皮纹理最美，将军们用来做战服。猪、狗皮最便宜，役夫们用来做鞋穿。西北少数民族地区看重水獭皮，用来镶饰细毛皮衣的领子。东北女真裹黄旗人翻山越岭猎取水獭后，卖到远方可得重价。不同地方的异兽，如金丝猴，其毛皮供皇帝做帽子。扯里猻的毛皮也供皇帝用作御袍，这都不是中原所出产的。用兽皮做衣的大致情况便是如此，各地特产不可尽述。飞禽之中有取鹰腹、雁腋的细毛作衣料的，杀生盈万才得一裘，名为“天鹅绒”，如何忍心穿呢？



be used to make lanterns. People who wear sheep coats get used to the odor, but people in the south are not used to it, and can not bear the odor. Since it is warm in the south, fur coats are not needed.

Deerskin can be used to make coats and trousers after the removal of hair and treatment in Glauber's salt. Such coats are warm and suitable to wear, and it is better to make shoes or socks with it. Deerskin is also produced in Guangdong, Hunan and Hubei provinces in the Central Plains of China. Wanghua Mountain is the place for exchanging deerskin. Another property of deerskin is that it wards off scorpions. Besides making clothes, people in North China also cut it into strips and use them as borders for bed coverings, which naturally keep scorpions away. The fur texture of the tiger and leopard furs is the most beautiful; army generals usually use them to make outfits for battles. The skins of pig and dog are the cheapest and labourers use them to make shoes. Minority tribes in the northwest areas like otter, and they inlay collars of fur coats with it. The Xianghuang sub-group of the Manchurian ethnical people in Northeast China hunt otters diligently and sell them to faraway places and they make considerable profits. There are various kinds of rare furs in different places such as the fur of *Phinopithecus roxellanae* can be used to make hats for emperors and the fur of *felix lynx* can be used to make gowns for emperors. These two kinds of animals are not found in the Central Plains. The above is a general description of the animal furs that have been used for clothing, not counting the numerous varieties of local products. Among fowls, the soft down on the belly of eagles and underarms of swallows can be used to make clothes. But making one coat requires a great number of these animals, and the resulting cloth is called velvet. How could one have the heart to wear such a coat?



【原文】

褐、毡

凡绵羊有二种，一曰蓑衣羊，剪其毳为毡、为绒片，帽袜遍天下，胥此出焉。古者西域羊未入中国，作褐为贱者服，亦以其毛为之。褐有粗而无精，今日粗褐亦间出此羊之身。此种自徐、淮以北州郡，无不繁生。南方唯湖郡饲畜绵羊，一岁三剪毛（夏季稀，革不生）。每羊一只，岁得绒袜料三双。生羔牝牡合数得二羔，故北方家畜绵羊百只，则岁入计百金云。

一种裔芳羊，唐末始自西域传来，外毛不甚蓑长，内毳细软，取织绒褐，秦人名曰山羊，以别绵羊。此种先自西域传入临洮，今兰州独盛，故褐之细者皆出兰州，一曰兰绒，番语谓之孤古绒，从其初号也。山羊毳绒亦分两等，一曰挡绒，用梳栉挡下，打线织帛，曰

【今译】

毛布、毛毡

绵羊有两种，一曰蓑衣羊，将其细毛剪下做成毛毡、绒片，遍布各地的毛线帽子和袜子，都以此为原料。古时西北的羊没有传入中原，下层人做衣用的毛布，也是这种羊毛做的。毛布只有粗的而没有细的，今天粗毛布也有用这种羊毛做的。这种羊从徐州地区和淮河以北各地都大量饲养。南方只有湖州饲养绵羊，一年剪三次毛（夏天毛稀，不长新毛）。一只羊每年所剪的毛可作三双毛袜用料。能生羔的公母羊交配可生二只小羊，故北方家养百只绵羊，一年可收入百两银子。

另一种绵羊叫羖羊，唐代末年从西域传来，外毛披散得不很长，但内毛细而柔软，可用来织绒毛布。陕西人叫山羊，以区别于绵羊。这种羊先从西域传到临洮，现在唯独兰州养得最多，故细毛布均出于兰州，又叫兰绒，西北少数民族语叫孤古绒，是根据早期的叫法。山羊细毛绒也分两等，一曰挡绒，是用梳篦从羊身上梳下的，打线织成毛布叫褐子、把子等名称。另一种叫拔绒，是细毛中的精细的，用两指甲逐根从羊身上拔下，再打线织成绒毛布。这种毛布织成后，



Woolens and Felt

There are two kinds of sheep. One is called coir raincoat sheep. Shear the sheep and the wool can be made into felt. It is the raw material of woolen hats and socks everywhere. In ancient times, before sheep in the northwest were introduced into the Central Plains, people of the lower classes also made clothes with wool from these sheep. All felt is coarse. Felt nowadays is made of this kind of wool too. A large number of these sheep are raised in the areas north of Xuzhou and the Huaihe River. In the south, sheep are only raised in Huzhou. People shear these sheep three times a year. (the hair is summer in sparse as no new hair grows.) The wool sheared from a sheep can be used to make three pairs of woolen socks. Male sheep mate with female sheep and they can produce two sheep at a time, so one family in the north which raises hundreds of sheep can get a hundred *liang* of silver a year.

The other kind of sheep is called Yule sheep. At the end of the Tang Dynasty, they were introduced from the northwest. The outer hair of the sheep is not very long, but their inner hair is fine and soft, which can be used to make fluffy cloth. People in Shanxi Province call them goats to distinguish them from the sheep. The goats were first introduced to Lintao, but they are mostly raised in Lanzhou. As all fuzzy cloth comes from Lanzhou, it is called "Lanzhou Wool". The fine hair of the goats can be divided into two types: one is "combed wool" which is combed down from the sheep. The cloth made of it is called serge, twill and so on. The other kind is called "picked wool". It is the finest and obtained by hand-picking it one by one. Cloth made of it feels as fine and smooth as silk. One can only get one *qian* (a unit of weight, equal to 1/10 *liang*) of thread from the hair picked each day, and can



【原文】

褐子、把子诸名色。一曰拔绒，乃毳毛精细者，以两指甲逐茎捋下，打线织成褐。此褐织成，揩面如丝帛滑腻。每人穷日之力打线只得一钱重，费半载工夫方成匹帛之料。若拈绒打线，日多拔绒数倍。凡打褐绒线，冶铅为锤坠于绪端，两手宛转搓成。

凡织绒褐机大于布机，用综八扇，穿经度缕，下拖四踏轮，踏起经隔二抛纬，故织出纹成斜现。其梭长一尺二寸。机织、羊种皆彼时归夷传来，故至今织工皆其族类，中国无与也。凡绵羊剪毳，粗者为毡，细者为绒。毡皆煎烧沸汤，投于其中搓洗，俟其黏合，以木板定物式，铺绒其上，运轴赶成。凡毡绒白、黑为本色，其余皆染也。其氍毹、氍毹等名称，皆华夷各方语所命。若最粗而为毯者，则弩马诸料杂错而成，非专取料于羊也。

【今译】

手摸布面就像丝帛那样光滑细腻。每人拔一天只能打出一钱重的线，费半年工夫才凑成一匹绒布用的毛料。若用拈绒打线，每天比拔绒多数倍。打毛布绒线用铅做成锤坠在线头上，用两手转动搓成绒线。

织绒毛布的织机大于织布机，用八片综，让经线从此通过，下面与四个踏轮相连，每踏起二根经线，过一次纬线，所以织成斜纹。织机的梭子长一尺二寸。这种织机和羊种都是当时东迁的新疆少数民族传来的，故至今织工皆其族类，很少有内地的人参与这一行业。从绵羊身上剪下的细毛，粗的做毡，细的做绒。做毡时将烧沸的水浇在羊毛中搓洗，待其相互黏合后，将其铺在具有一定大小的木板上，用转轴赶压而成。白色和黑色是毡绒的本色，其余颜色都是染成的。氍毹、氍毹等名称，都是根据各地方言命名的。做毯子所用的最粗的毛，里面掺杂了劣种马的毛等料，并非都是取料于羊毛。



only get one bolt of cloth made of it each half a year. The amount of the “combed wool” that can be spun in a day is several times that of the “picked wool”. Use lead as a hammer and hang the hammer at one end of the thread, turn it with two hands and twine it into wool threads.

The loom for weaving wool fabrics is larger than the cotton looms. Eight cross beams are employed on a wool loom; the wool yarns are placed on the warp beam and passed through their respective harness slots. The harness is lifted by stamping the four treadles under the frame. This is to separate the warp yarns over two weft yarns. The result is that a diagonal pattern is created across the face of the finished fabric. The shuttle of the machine is one *chi* and two *cun* long. The machine and sheep were all introduced by the minority people from Xinjiang, so the weavers are all members of this minority group. Few inlanders take part in this work. Coarse hair sheared from the sheep is used to make felt, while the fine ones are used to make fuzzy cloth. When felt is made, put the wool into boiling water until it becomes agglutinative; spread it on a wooden board of a certain size; and press it with a shaft. The true colors of felt are black and white; the others are dyed. *Quyu* blankets, and *pulu* blankets from Tibet and the like are all named according to the dialects in those places. The coarsest kinds of blankets are made with horsehair and shoddily mixed with sheep’s wool.



彰 施 第 七

【原文】

宋子曰，霄汉之间云霞异色，阎浮之内花叶殊形。天垂象而圣人则之，以五彩彰施于五色，有虞氏岂无所用心哉？飞禽众而凤则丹，走兽盈而麟则碧。夫林林青衣望阙而拜黄朱也，其义亦犹是矣。君子曰，甘受和，白受采。世间丝、麻、裘、褐皆具素质，而使殊颜异色得以尚焉。谓造物而不劳心者，吾不信也。

诸色质料

大红色：其质红花饼一味，用乌梅水煎出，又用碱水澄数次。或稻稿灰代碱，功用亦同。澄得多次，色则鲜甚。染房讨便宜者先染

【今译】

宋子说，天上的云霞五颜六色，地上的花叶千姿百态。大自然呈现的这些彩色缤纷的景象，古代的圣人便加以摹仿，以染料把衣服染成青、黄、赤、白、黑等颜色穿在身上。虞舜当初就是有意这样做的。飞禽众多而只有凤凰丹红超群，走兽遍野而只有麒麟青碧异常。让许多百姓身着黑衣，望见皇宫里穿黄带朱的权贵而敬拜，也含有这层意义。君子说，“甘甜可调和众味，白料能染成诸色”。世上丝、麻、皮、布都是素料，因而可以染成各种不同的颜色而受到珍重。我不相信这不是大自然作出的精心安排。

各种染料

染大红色：原料只有红花饼一种，用乌梅水煎煮红花饼，再用碱水澄清几次。也可以用稻草灰代替碱，作用是一样的。澄清多次后，颜色便特别鲜艳。染房为图便宜，先用枥木水打底色，再用红花水染。红花最忌与沉香、麝香相遇。如果红色的衣服与熏衣的这



Chapter 7

Dyes

Songzi says that clouds in the sky are colorful, and flowers and leaves on the ground are of various shapes. The sages in ancient times copied the color in nature; they dyed clothes various colors, such as green, yellow, red, white and black with dyes and wore them. Emperor Shun did this on purpose. Among the many birds, the red color of phoenix is the most dazzling; among all the beasts the green of the unicorn—a mythical horned beast is the most special. So many common people wear black clothes; they admire and respect the noble in royal palace who wear yellow and red clothes. Junzi once said, “The bland will absorb a mixture of tastes, and the white will absorb the rainbow colors.” All the silk, hemp, fur and woolen stuffs are naturally plain, so they can be dyed different colors which make them valuable. This is the elaborate arrangement of nature.

Dyestuff Needed to Dye Various Colors

Raw materials are just safflower (*Carthamus tinctorius*) cakes. Cook it in smoked plum water and wash it several times in alkali water. Alkali water can be replaced by rice straw ash water. The color will be very bright after washing. To save money, some dyeing houses dye cloth in smoked tree (*Cotinus coggia*) water first, as a base, and then dip the cloth into safflower water. Safflower, eaglewood and musk can not be placed together. Store red clothes and these spices together, the red will disappear within a month. Wet the dyed red silk and drip



【原文】

芦木打脚。凡红花最忌沉、麝，袍服与衣香共收，旬月之间其色即毁。凡红花染帛之后，若欲退转，但浸湿所染帛，以碱水、稻灰水滴上数十点，其红一毫收转，仍还原质。所收之水藏于绿豆粉内，放出染红，半滴不耗。染家以为秘诀，不以告人。

莲红、桃红色、银红、水红色：以上质亦红花饼一味，浅深分两加減而成。是四色皆非黄茧丝所可为，必用白丝方现。

木红色：用苏木煎水，入明矾、梣子。

紫色：苏木为地，青矾尚之。

赫黄色：制未详。

鹅黄色：黄蘗煎水染，靛水盖上。

金黄色：芦木煎水染，复用麻稿灰淋，碱水漂。

茶褐色：莲子壳煎水染，复用青矾水盖。

大红官绿色：槐花煎水染，蓝靛盖，浅深皆用明矾。

豆绿色：黄蘗水染，靛水盖。今用小叶苋蓝煎水盖者，名草豆绿，色甚鲜。

【今译】

些香料收藏在一起，个把月内衣服就要褪色。用红花染丝织物以后，若想退还本色，只要将染过的丝织物浸湿，并滴上数十滴碱水或稻灰水，红色就一点也没有了，仍恢复到原来的素色。剩下的红水在绿豆粉内收藏，取出来再染红，一点都不损失。染房把这一招当作秘方，不肯告人。

染莲红、桃红色、银红、水红色：染以上四种颜色的原料，也是用红花饼，色的深浅视染料用量的增减而定。这四种颜色都不能用黄茧丝来染，必须用白丝才能呈色。

染木红色：用苏木煎水，加入明矾、五倍子。

染紫色：用苏木水打底，再配上青矾。

染赭黄色：方法不详。

染鹅黄色：用黄蘗水先染，再用蓝靛水套染。

染金黄色：用芦木煮水染，再用麻秆灰淋出的碱水漂洗。

染茶褐色：用莲子壳煮水染，更用青矾水媒染。

染大红官绿色：用槐花煮水染，以蓝靛套染。不管颜色是深是浅，都要用明矾。

染豆绿色：用黄蘗水染，再以蓝靛套染。现在用小叶苋蓝煮水套染的名叫草豆绿色，很鲜艳。



ten drops of alkali water or rice straw ash water, and the red color will fade away to the original color. This liquid is stored in green lentil flour and can be released again for dyeing with no loss. Information about this process is not obtainable from dyers, who regard it as a trade secret.

The raw material used to dye lotus pink, peach-blossom pink, silver pink and clear pale pink is also safflower cakes. The shade of color depends on the amount of dye. These colors will not show on yellow silk; therefore, white silk must be used.

Dye for wood red is made by boiling sapanwood in water, with gallnuts and alum added.

Purple is achieved by using sapanwood as a base, then dyeing again with green vitriol.

The method for dyeing earth brown is not clear.

Canary yellow is dyed first with the aqueous solution of boiled yellow berberine wood and then soaked in the indigo water.

Golden yellow is achieved first by dyeing with the aqueous solution of boiled Venetian sumach wood, followed by shampooing with the alkaline solution of water-leached hemp ash.

Tea brown is dyed with the aqueous solution of boiled lotus-seed shells and then rinsed with the aqueous solution of green vitriol.

Dark green is gotten first with the juice of boiled pagodatree flower and next soaked in indigo solution. Alum is used as a mordant for both the light and darker shades of this color.

Bright green is dyed first with the liquid of boiled yellow berberine and then soaked in indigo solution. Nowadays there is a shade called bright grassgreen, which is gotten by using the liquid of boiled small-leaved *Polygonum tinctorium* plant after dyeing with yellow berberine; this brings about a very brilliant blue.



【原文】

油绿色：槐花薄染，青矾盖。

天青色：入靛缸浅染，苏木水盖。

葡萄青色：入靛缸深染，苏木水盖。

蛋青色：黄蘗水染，然后入靛缸。

翠蓝、天蓝：二色俱靛水分深浅。

玄色：靛水染深青，芦木、杨梅皮等分煎水盖。又一法，将蓝芽叶水浸，然后下青矾、楮子同浸，令布帛易朽。

月白、草白：二色俱靛水微染，今法用苋蓝煎水，半生半熟染。

象牙色：芦木煎水薄染，或用黄土。

藕褐色：苏木水薄染，入莲子壳、青矾水薄盖。

染包头青色：此黑不出蓝靛，用栗壳或莲子壳煎煮一日，漉起，然后入铁砂、皂矾锅内，再煮一宵即成深黑色。

【今译】

染油绿色：用槐花水薄染，再用青矾水媒染。

染天青色：在靛缸中染成浅蓝色，再用苏木水套染。

染葡萄青色：在靛缸中深染，再用浓苏木水套染。

染蛋青色：用黄蘗水染，然后入靛缸中再染。

染翠蓝、天蓝色：这两种颜色都用蓝靛水染成，只是略分深浅。

染玄色：用蓝靛水染成深蓝色，再用等量芦木、杨梅皮水煮后套染。另一种方法是用蓝的嫩叶做成的染液浸染，然后下青矾、五倍子一起浸染。但用这种方法容易使布和丝料朽烂。

染月白、草白：两种颜色都用蓝靛水轻轻一染。现在的方法是将苋蓝煮到半生半熟时染之。

染象牙色：用芦木煮水微染，或用黄土染。

染藕褐色：用苏木水微染，再用莲子壳、青矾水微染。

染包头巾用的青色：这种黑色不是用蓝靛染成的，而是将栗壳或莲子壳用水煮一天，滤出，然后放在锅内，加入铁砂、皂矾，再煮一个晚上，就成为黑色。



Light green is slightly dyed with pagodatree flower liquid and soaked in green vitriol solution.

Deep sky blue can be gotten from first dyeing the material lightly in a vat of indigo and then washing with sapanwood solution.

Grape blue is obtained by dyeing the material in a vat of indigo and then washing it with concentrated sapanwood solution.

Egg-shell blue is gotten by first dyeing the cloth with yellow berberine solution then soaking it in indigo vats.

Peacock blue and sky blue are dyed with indigo, the difference being only one of shade.

Black is first dyed a deep blue with indigo water then soaked in the liquids of boiled Venetian sumach wood and afterwards in those of boiled myricaceae bark. According to another method, the tender indigo leaves are first soaked in water; next, green vitriol and gallnuts are added, and with the cloth are soaked together in this liquid. Cloth dyed in this fashion, however, will deteriorate rapidly.

Pale blue and light blue are both obtained by dyeing slightly in an aqueous solution of indigo. A new method nowadays consists of dyeing in the slightly boiled liquid of *Polygonum tinctorium*.

Ivory color is obtained by dyeing slightly in the liquid of Venetian sumach, or in an aqueous solution of yellow earth.

Mauve is dyed first in a dilute sapanwood solution, followed by soaking in the dilute liquids of lotus-seed shells and of blue vitriol, respectively.

The dyeing of black kerchiefs. This black color is not obtained from indigo. The material to be dyed is first boiled for a day in a mixture of water and acorn shells or lotus-seed shells, and strained off; and is then boiled for one night in a pot containing the aqueous solution of iron ore and green vitriol. This results in a deep black color.



【原文】

染毛青布色法：布青初尚芜湖，千百年矣，以其浆碾成青光，边方外国皆贵重之。人情久则生厌。毛青乃出近代，其法取松江美布染成深青，不复浆碾，吹干，用胶水掺豆浆水一过。先蓄好靛，名曰标缸，入内薄染即起。红焰之色隐然，此布一时重用。

蓝 靛

凡蓝五种皆可为靛。茶蓝即菰蓝，插根活。蓼蓝、马蓝、吴蓝等皆撒子生。近又出蓼蓝小叶者，俗名苋蓝，种更佳。

凡种茶蓝法，冬月割获，将叶片片削下，入窖造靛。其身斩去上下，近根留数寸，薰干，埋藏土内。春月烧净山土，使极肥松，然后用锥锄（其锄勾末向身，长八寸许）刺土打斜眼，插入于内，自然活根

【今译】

毛青布染色法：布青色最初是在芜湖流行起来的，至今已有千百 years 了。因为浆碾后发出青光，边远地区和外国都很看重它。但看惯了的东西久则生厌，这是人之常情。于是近世又推出了毛青布，其制法是用松江好布染成深青色，不要浆碾，吹干后在胶水和豆浆中过一次。事先存放最好的蓝靛，叫标缸，将布在其中轻轻一染，然后取出。青布中便隐现出红光，这种布曾一时被看重。

蓝 靛

植物中蓝共有五种，都可以做蓝靛。茶蓝也就是菰蓝，只要插根就能成活。但蓼蓝、马蓝、吴蓝等，则必须撒子而生。近来又出现一种小叶蓼蓝，俗名为苋蓝，是更好的品种。

种茶蓝的方法是，在立冬之月收割，将茶蓝上的叶子一片一片地摘下来，放入窖中造蓝靛。剩下的茶蓝茎秆的上下部要切去，只留靠根的部位数寸，晒干后埋在土里。来年春天时，烧掉山上的杂草，使土地肥沃、疏松，然后用锥锄（其锄勾勾头向内弯曲，锄长八寸）



Dyeing of navy-blue cloth. For many centuries Wuhu was famous for its dark blue cloth. Its blue sheen, a result of this locality's starching and smoothing process, was highly valued by peoples of countries far and near. Yet it is human nature that people grow finally tired of this material because they have been using it for such a long time, therefore a method for dyeing the navy-blue color has been developed in recent times. This new method can be described as follows: the Songjiang cloth of superior quality is first dyed a dark blue and is dried in the air without the starching and smoothing treatments. Next rinse the cloth in an aqueous solution of glue and bean milk. Then dye the cloth slightly in a vat of the highest grade of indigo called "standard vat". Thus the finished product will show a red iridescence, and it has become much valued.

Indigo

There are five kinds of indigo plants, all of which yield indigo. *Isatis tinctoria* can grow once its root is inserted into the soil. However, *Polygonum tinctorium*, *Acanthaceae indigo* and *Indigofera tinctoria* can only grow by planting seeds. There is another kind of blue, called "Pigweed indigo" (*Amarantaceae tinctorium*), which is a better kind.

The way to grow *Isatis tinctoria* to make indigo is like this: harvest it in October of the Chinese lunar calendar, pick off leaves on it one by one and put them in pits. Cut off the upper and lower parts of the remaining stalk, only leaving several *cun* close to the root. Bury it in the ground after drying it off in the sun. Burn the grass in the mountains the following spring to make the soil fertile and loose; dig a slant hole with a hoe (This hoe is about eight inches in length with a curved head.) and in-



【原文】

生叶。其余蓝皆收子撒种畦圃中。暮春生苗，六月采实，七月刈身造靛。

凡造靛，叶与茎多者入窖，少者入桶与缸。水浸七日，其汁自来。每水浆一石下石灰五升，搅冲数十下，靛信即结。水性定时，靛沉于底。近来出产，闽人种山皆茶蓝，其数倍于诸蓝。山中结箬篓输入舟航。其掠出浮沫晒干者，曰靛花。凡靛入缸，必用稻灰水先和，每日手执竹棍搅动，不可计数。其最佳者曰标缸。

红 花

红花，场圃撒子种，二月初下种。若太早种者，苗高尺许即生虫如黑蚁，食根立毙。凡种地肥者，苗高二三尺。每路打橛，缚绳横拦，以备狂风拗折。若瘦地，尺五以下者，不必为之。

【今译】

掘土打成斜洞，将茶蓝茎段插入其中，根部自然会成活而生出叶子。其余各种蓝都是收子作种，撒在畦圃里。春末出苗，六月采子，七月割蓝造靛。

造蓝靛时，要是叶与茎很多，便放在窖里，少的放入桶内或缸内。用水浸泡七天，自然会浸出蓝液。每一石蓝液放入石灰五升，搅动数十下，蓝靛很快就会结成。静放后，蓝靛便沉于底部。近来所生产的蓝靛，多是用福建人在山上遍种的茶蓝制得，其数量比其余各种蓝的总和还要多好几倍。他们在山上将茶蓝装入竹篓内，由船运到外地出售。制造蓝靛时，将漂在上面的浮沫取出晒干，名曰靛花。放在缸内的蓝靛，必须先和以稻灰水，每天手持竹棍不计次数地搅动，其中最好的叫做标缸。

红 花

红花是在园圃中用种子种的，二月初下种。如果种得太早，待苗高一尺时，就会有黑蚂蚁般的虫子将根吃掉，使苗死亡。种红花的土地肥沃时，苗可长到二三尺高。这就要在每行打桩，绑上绳子将苗横拦起来，以防狂风折断。如土地不肥，苗只长到一尺五寸以下时，就不必这样做了。



sert the remaining part of the indigo into it. The root will grow leaves. Others are grown by planting seeds in the garden. Seedlings appear at the end of spring; pick seeds in June and make indigo in July of Chinese lunar calendar.

In making indigo, if there are many leaves and stems, put them in pits; if there are few, put them in a bucket or jar. Dip them in water for seven days, and blue liquid will appear naturally. Put five *sheng* of lime in each one *dan* of solution; stir the mixture ten times or so, and indigo will form in a short time. Indigo will sink to the bottom after the stirring stops. Most of the indigo produced recently is made from *Isatis tinctoria* planted all over the mountains in Fujian Province; the amount is over several times as much as the sum of the other four kinds of indigo. People put *Isatis tinctoria* in bamboo baskets and ship it to other places for sale. Take out froth and dry it in the sun, and this is called *Indigo naturalis*. Indigo in a jar must be mixed with rice stalk ash water first, and stirred many times a day with a bamboo stick.

Safflower

Safflower is grown by seeds. Plant seeds in the garden at the end of February according to the Chinese lunar calendar. If seeds are planted too early, the seedlings will be eaten by insects like black ants when the young plants are a *chi* high, and they will die. Safflower planted in fertile soil can grow to two or three *chi* high. Stakes should be fixed along each row and strings tied across them, in order to prevent the plants from being broken by strong winds. When the soil is not fertile, the plants will only grow to less than one and a half *chi*. It is not necessary to pitch stakes in that case.



【原文】

红花入夏即放绽，花下作球彙多刺，花出球上。采花者必侵晨带露摘取。若日高露干，其花即结闭成实，不可采矣。其朝阴雨无露，放花较少，干摘无妨，以无日色故也。红花逐日放绽，经月乃尽。入药用者不必制饼。若入染家用者，必以法成饼然后用，则黄汁净尽，而真红乃现也。其子煎压出油，或以银箔贴扇面，用此油一刷，火上照干，立成金色。

造红花饼法

带露摘红花，捣熟，以水淘，布袋绞去黄汁。又捣以酸粟或米泔清，又淘，又绞袋去汁。以青蒿覆一宿，捏成薄饼，阴干收贮。染家得法，“我朱孔阳”，所谓猩红也。（染纸吉礼用，亦必用紫饼，不然全无色。）

【今译】

红花一入夏就开花，花下面是多刺的球状花苞。采花的人必须在凌晨带露水时摘取，若等太阳升起、露水干时，花就已经闭合而不能采了。当早晨阴雨而没有露水时，花开得较少，晚一点摘也无妨，因为没有太阳照射。红花逐日开放，经一个月才开尽。红花作药用时，不必做成饼。若在染坊中使用，则必须依法做成饼而后用。做成饼后，其中的黄液除尽，才能显出真正的红色。用红花子实煎煮后榨出的油，刷在贴有银箔的扇面上，在火上烘干，立即成为金色。

造红花饼的方法

将带着露水摘取的红花捣烂，放入布袋中用水淘洗，并绞去黄色液体。然后取出来再捣，放入布袋中用发酸的淘米水再次淘洗，再绞去汁液。用青蒿在上面盖一夜，捏成薄饼，阴干后收藏起来。如染法得当，就会染出鲜红的颜色，即所谓猩红色。（染贺帖用的大红纸，也必须用红花饼来染，否则染不出大红色来。）



Safflower begins to bloom in early summer. It is a ball-like thorny flower bulb at the bottom of a flower. Flower pickers must pick the flowers early in the morning when they have dew on them. If the sun has risen, and dew is gone, the flowers will close. When it is rainy in the morning and there is no dew, the flowers will bloom a little later. Because there is no sun, it is all right to pick late. Safflowers bloom day after day; it will continue to bloom every day for a whole month. It is not necessary to squeeze the flowers into cakes when they are used to make medicines. If used in dye houses, safflower must be squeezed into cakes for use. When they are cakes, yellow water in it will be completely removed, and the true red color will appear. The seeds of safflower can be pressed for oil. A silver-leafed fan will turn golden after having been brushed with this oil and dried over a fire.

The Making of Safflower Cakes

First the safflower blossoms are picked when they are still with dew, and are thoroughly pounded. Then the pounded mass is put into a cloth sack and washed in water and squeezed to remove the yellow matter. After that the mass is taken out of the sack and pounded again. And it is put in the bag and washed with soured water, which is used to wash millet or rice, and finally it is squeezed to remove the yellow matter. Then this solid residue is covered with branches of *Artimisia apiacea* for one night, after which it is made into cakes, dried in the shade, and stored. When dyers know the correct method of making safflower cakes, bright red can be obtained, known as scarlet (safflower cakes are also necessary in dyeing red paper for ceremonies; otherwise the color would not be bright).



【原文】

附：燕脂、槐花

燕脂，古造法以紫饼染绵者为上，红花汁及山榴花汁者次之。近济宁路但取染残红花滓为之，值甚贱。其滓干者名曰紫粉。丹青家或收用，染家则糟粕弃也。

凡槐树十余年后方生花实。花初试未开者曰槐蕊，绿衣所需，犹红花之成红也。取者张度箕稠其下而承之。以水煮一沸，漉干捏成饼，入染家用。既放之花，色渐入黄，收用者以石灰少许洒拌而藏之。

【今译】

附：燕脂、槐花

制造燕脂的古方以染丝的紫饼为上料，而红花汁及山石榴花汁次之。近来山东济宁只用染剩的红花滓来做燕脂，价钱很便宜。干的红花滓叫紫粉，画家或可用上，但染房便当作糟粕扔掉。

槐树要在生长十多年后才开花结实。含苞待放的槐花叫槐蕊，染绿色衣料时所必需，就像红花可以染成红色一样。采取槐花时要用竹筐密布在树下来接取，将槐花用水煮沸，取出滤干并捏成饼，放染房中用。已开过花，颜色逐渐变黄，收用槐花时必须洒拌少量石灰，然后贮藏。



Supplement: Rouge and Pagodatree Flower

Among raw materials used to make rouge in ancient times, *Bengal kino* which was used to dye silk is the best, with safflower juice or mountain pomegranate flowers next to it. Recently, people in Jining of Shandong Province use the leftover of safflower as rouge. This is very cheap. The dry leftover safflower is called purple powder. Calligraphers and artists use it; however, dyeing houses just throw it away considering it as waste.

Pagodatree Flower. It will take more than ten years before pagodatreess bloom and bear fruit. The immature, unopened flowers are called pagoda tree flower buds, which is a necessary ingredient in dyeing cloth green, just as safflower is in dyeing it red. To gather the buds, bamboo mats are spread closely under the tree to receive them. The buds are then boiled once in water, strained, and squeezed into cakes; they are now ready for use by dyeing houses. Flowers that have bloomed will gradually turn yellow. After being gathered they are mixed with a little lime, dried in the sun, and stored for use.



天工开物·卷中

五金第八

【原文】

宋子曰，人有十等，自王公至于舆台，缺一焉而人纪不立矣。大地生五金以利天下与后世，其义亦犹是也。贵者千里一生，促亦五六百里而生。贱者舟车稍艰之国，其土必广生焉。黄金美者，其值去黑铁一万六千倍，然使釜鬻、斤斧不呈效于日用之间，即得黄金，值高而无民耳。贸迁有无，货居《周官》泉府，万物司命系焉。其分别美恶而指点重轻，孰开其先，而使相须于不朽焉？

黄金

凡黄金为五金之长，熔化成形之后，住世永无变更。白银入洪炉虽无折耗，但火候足时，鼓鞴而金花闪烁，一现即没，再鼓则沉

【今译】

宋子说，人有十个等级，从高贵的王公直到低贱的舆台，缺其中之一，则等级制度便无从建立。大地产生出五金，以利于天下与后世，其道理也和人分成贵贱是一样的。贵金属要隔千里才有一处产地，近的也要隔五六百里才有一处。贱金属就是在舟车难通之处，也必广泛出产。上好的黄金价值比黑铁高一万六千倍，然而如果没有铁制的锅、斧应用于日常生活中，即使有黄金，价值虽高，并不有益于人民。在互通有无的贸易中，金属货币居于《周礼·地官》所载泉府那样的地位，掌握着万物的命脉。至于分辨金属的优劣、品评其价值的轻重，是谁开的头，而使金属永远是必需之物呢？

黄金

黄金是五金之首，熔化成形之后，永远不发生变化。白银入熔炉熔化虽然没有损耗，但火候足时，用风箱鼓风会闪烁出金属的火花，但一现即没，再次鼓风则消失而不出现。只有黄金当极力鼓风时，一



Volume II

Chapter 8

Metallurgy

Songzi says that people are classified into ten classes ranging from noble kings and dukes to sedan chair bearers, without any of whom the hierarchy will not be established. In a similar manner, the earth produces different metals for the benefits of all the human beings. The precious metals are found once in a thousand *li* or at least five hundred *li*. The less valuable metals can be easily found even in places that are inaccessible to boats or carts. The value of top-grade gold is 16,000 times than that of black iron. However, if there are no iron boilers and iron axes used in daily lives even valuable gold will not be beneficial to human beings. The livelihood of all depends on the trading of what the people have for what they have not, as provided in the chapter on goods and exchange in *The Rites of Zhou*. Then who was the first one to judge metals' qualities and their values which make them the necessities forever?

Gold

Gold is the highest in value among all the metals and will never change its quality after the melting and shaping processes. Silver, on the other hand, though it does not have any loss when melted in the forge, requires that the final blow of the bellows be struck at the right time, when the silver will flash its gleam once; thereafter it will not appear again despite continued use of the bellows. The stronger the fire,



【原文】

而不现。唯黄金则竭力鼓鞴，一扇一花，愈烈愈现，其质所以贵也。凡中国产金之区大约百余处，难以枚举。山石中所出，大者名马蹄金，中者名橄榄金、带胯金，小者名瓜子金。水沙中所出，大者名狗头金，小者名麸麦金、糠金。平地掘井得者名面沙金，大者名豆粒金。皆待先淘洗后、冶炼而成颗块。

金多出西南，取者穴山至十余丈见伴金石，即可见金。其石褐色，一头如火烧黑状。水金多者出云南金沙江（古名丽水），此水源出吐蕃，绕流丽江府，至于北胜州，回环五百余里，出金者有数截。又川中潼川等州邑与湖广沅陵、溆浦等，皆于江沙水中淘沃取金。千百中间有获狗头金一块者，名曰金母，其余皆麸麦形。

入冶煎炼，初出色浅黄，再炼而后转赤也。僇崖有金田，金杂沙土之中，不必求深而得。取太频则不复产，经年淘炼，若有则限。然岭南夷獠洞穴中，金初出如黑铁落，深挖数丈得之黑焦石下。初

【今译】

鼓则金属火花闪现一次，火力越猛烈，金花越多，这是黄金之所以珍贵的原因。中国产金的地区大约有百余处，难以枚举。山石中所出之金，大的叫“马蹄金”，中等的叫“橄榄金”、“带胯金”，小的叫“瓜子金”。从水沙中所出的，大的叫“狗头金”，小的叫“麸麦金”、“糠金”。在平地掘井而得到的金叫“面沙金”，大块的叫“豆粒金”。都要先经淘洗后，再冶炼而成颗块形的金。

金多半出产于西南，采金人在山上挖至十余丈深见到伴金石时，便可见到金。其石呈褐色，一头像火烧黑了似的。水金多产于云南金沙江（古代叫丽水），此水发源于吐蕃，绕过云南丽江府，再到云南永胜，曲折五百余里，出金处有几段地方。此外四川北部潼川等地与湖南沅陵、溆浦等地，都可在江沙水中淘得砂金。在千百次淘取中，偶尔才会获得一块狗头金，名叫“金母”，其余都是麸麦形的小粒。

金在入炉冶炼后，刚出炉时呈浅黄色，再炼后才转变成赤色。僇州、崖州两地有金田，金夹杂在沙土之中，不必挖太深即可取得。但取得太频繁，则不再出产。多年淘炼，如果有金也是有限的。然而五



the more the gleam emerges. This is the reason why gold is so rare. Gold is produced in over a hundred places in China. Among the gold produced from the mines in mountains, the larger pieces are called "horse-shoe gold", the medium "olive gold", or "pendant gold", and the small ones "melon-seed gold". Of the gold obtained from water and sand, the large pieces are called "dog-head gold" and the small "wheat-husk gold" or "chaff gold". The gold obtained by underground mining is called "sand-powder gold", but the larger size is known as "bean gold". All these varieties of gold need to be washed and smelted before they can be made into nuggets.

Most gold is produced in Southwest China. The miners dig tunnels of over ten *zhang* deep into the hillside. Gold is usually found protected by some particular stones, which are brown, one end having a charred appearance. The placer gold is mostly in the Jinsha River (called Li Shui in ancient times) in Yunnan Province which rises in Tubo (Tibet), flows through the YongSheng. The river twists for more than five hundred *li*. Additionally, gold can be found by panning in rivers of Tongchuan in the north of Sichuan Province, Yuanling and Xupu of Huguang (Hunan) Province. Only one big piece of gold called "mother gold" can be obtained in the panning processes after thousands of times. The rest look like wheat chaff.

After being smelted in furnaces, gold, shortly after being taken out, looks buff, but it will turn reddish after being smelted again. In Danzhou and Yazhou there are gold mines where gold is mixed in the sand and is easily found without deep digging. The gold will be exhausted if frequent digging is continued; gold becomes limited after years of digging. In the caves in the minority areas south of Wuling Mountains, however, the gold, shortly after mining, looks like black



【原文】

得时咬之柔软，夫匠有吞窃腹中者，亦不伤人。河南蔡巩等州邑，江西乐平、新建等邑，皆平地掘深井取细沙淘炼成，但酬答人功，所获亦无几耳。大抵赤县之内，隔千里而一生。《岭表录异》云，居民有从鹅鸭屎中淘出片屑者，或日得一两，或空无所获。此恐妄记也。

凡金质至重。每铜方寸重一两者，银照依其则，寸增重三钱。银方寸重一两者，金照依其则，寸增重二钱。凡金性又柔，可屈折如柳枝。其高下色分七青、八黄、九紫、十赤。登试金石（此石广信郡河中甚多，大者如斗，小者如拳。入鹅汤中一煮，光黑如漆）上立见分明。凡足色金掺和伪售者，唯银可入，余物无望焉。欲去银存金，则将其金打成薄片剪碎。每块以土泥裹涂，入坩埚中硼砂熔化，其银即吸入土

【今译】

岭以南少数民族地区的洞穴中，初采出的金像黑铁粉，深挖数丈得之于黑焦石下面。初得的金咬起来柔软，匠人有偷吞到腹中的，亦不伤人。河南上蔡、巩县和江西乐平、新建等地，都在平地挖深井，取出细沙淘炼而成，但耗费人工很多，所获无几。大体说，中国境内每隔千里有一处产金。《岭表录异》云，居民有从鹅鸭屎中淘出金屑者，或一日得一两，或空无所获。这恐怕是荒诞的记载吧。

金是很重之物。假定一寸见方的铜重一两，照这样来算，则一寸见方的银要增重三钱。假定一寸见方的银重一两，则一寸见方的金要增重二钱。金又有柔性，可屈折如柳枝。区分金的成色高低，大抵七成金呈青色，八成金呈黄色，九成金呈紫色，十成足金呈赤色。将金放在试金石（此石在江西广信府河中甚多，大者如斗，小者如拳。将其放入鹅汤中一煮，则光黑如漆）上测试，则成色立见分明。在足色金中掺和作伪而出售，只可加入银，加其余金属都不可以。要想将其中的银除去而只存金，便要将金打成薄片并剪碎。每片用泥土裹涂，放入坩埚中



iron powder. It is obtained from under the black carbonaceous stones in pits several dozen-*zhang* deep in the earth. This gold at first is soft to the bite. Sometimes the miners steal this kind of gold by swallowing it, which does not do any harm to them. In such areas as Shangcai and Gong counties of Henan Province, Leping and Xinjian of Jiangxi Province, gold is obtained by washing and smelting fine sand which has been mined from the deep shafts dug into the ground. This method, however, takes too much manpower while the gold obtained is not worth much. Generally speaking, there must be an area producing gold every thousand *li* in China. It is recorded in the book “*Ling Biao Lu Yi*” that the people in Guangdong washed goose and duck droppings for gold flakes and bits, some getting one *liang* in a day and others none. This is probably not true.

Gold is a heavy metal. If a piece of one square *cun* copper weighs one *liang*, a piece of silver of the same size will be 3 *qian* heavier. If a piece of one square *cun* silver weighs one *liang*, gold of the same size will be 2 *qian* heavier. Gold is as soft as willow twigs. Gold with purity of 70 per cent looks black, 80 per cent yellow, 90 per cent purple and 100 percent red. This can be easily determined by placing the gold upon a “gold-testing stone” (These kinds of stones can be easily found in the rivers of Guangxin Prefecture of Jiangxi. Their sizes range from a *dou* rice-measuring vessels to a human fist. They will become as dark as lacquer after being boiled in goose soup). Only silver, no other metals, can be mixed with pure gold for forging. In order to separate gold from silver, cut the gold into slices and cut these slices into pieces. Wrap every piece with clay before putting it into a crucible and melting it in borax. In this way, the silver mixed with the gold will be absorbed into the clay, and the pure gold will be separated. Put the clay together with a little lead into another



【原文】

内，让金流出以成足色。然后入铅少许，另入坩埚中，勾出土内银，亦毫厘具在也。

凡色至于金，为人间华美贵重，故人工成箔而后施之。凡金箔每金七分，造方寸金一千片，粘铺物面可盖纵横三尺。凡造金箔，既成薄片后，包入乌金纸内，竭力挥椎打成（打金椎短柄，约重八斤）。凡乌金纸由苏杭造成，其纸用东海巨竹膜为质。用豆油点灯，闭塞周围，只留针孔通气，熏染烟光而成此纸。每纸一张打金箔五十度，然后弃去，为药铺包朱用，尚未破损。盖人巧造成异物也。

凡纸内打成箔后，先用硝熟猫皮绷急为小方板。又铺线香灰撒幔皮上，取出乌金纸内箔覆于其上，钝刀界画成方寸。口中屏息，手执轻杖，唾湿而挑起，夹于小纸之中。以之华物，先以熟漆布地，然后粘贴。秦中造皮金者，硝扩羊皮使最薄，贴金其上，以便剪裁服饰

【今译】

加硼砂熔化，金中的银即吸入土内，让金流出成为足金。然后加入铅少许，将土另入坩埚内熔化，就可从土中再提出银，丝毫也不会损失。

金的颜色是人间华美而贵重的颜色，所以用人工打成金箔而后用于装饰。每七分黄金可打成一平方寸的金箔一千片，将其粘贴在器物表面，可覆盖纵横三尺的面积。制造金箔时，先将金打成薄片，再包在乌金纸中，极力挥槌打成（打金箔的槌子是短柄的，约重八斤）。乌金纸由苏州、杭州制造，这种纸用东海的巨竹膜为原料。用豆油点灯，将灯周围封闭，只留一针眼大的通气孔，用灯烟将纸熏染成乌金纸。每张纸可打金箔五十槌，然后弃去。弃去的纸供药铺包朱砂用，尚未破损。靠人的技巧能造出来奇异之物。

金子在乌金纸内打成金箔后，先将芒硝鞣制的猫皮绷紧成为小方形皮板，再将香灰铺撒在皮面上，将乌金纸里面的金箔覆盖在上面，用钝刀画出一平方寸的方格。这时操作的人暂屏呼吸，手持轻棍用唾液沾湿金箔，将其挑起并夹在小纸之中。用金箔装饰物件，先以熟漆铺底，再将金箔粘贴上去。陕西造皮金的人则用鞣过的羊皮拉紧至极薄，将金箔粘贴在上面，以便剪裁供服饰用，都显出辉煌的金色。金箔粘贴的物件，当他日破旧不用时，将其削刮下来以火烧之，其金质



crucible and melt it. Then the silver will be separated without any loss.

Gold looks gorgeous and noble so it is stricken into gold foil for decoration. Every seven *fen* of gold can be stricken into 1,000 pieces of gold foil of one square *cun* which can be used to stick onto the surface of an object covering the area of nine square *chi*. In the process of making gold foils, strike the gold into slices and then wrap them with black gold paper before striking them hard with pestles (which have short handles and weigh about eight *jin*) This kind of paper is produced in Suzhou and Hangzhou with the fibres of grand bamboos from Donghai. Light a lamp with bean oil and cover the lamp, leaving only a blowhole as big as an eyelet. The paper is smoked with the lamp into the black gold paper. Every piece of paper can be thrown away after being stricken fifty times by the pestles. This discarded paper can still be used to wrap cinnabar in herbal medicine shops without any damage. This rare stuff is produced all by human hands.

Cover a small square cat leather board tanned with Glauber's salt and dredged with incense ashes with gold foil stricken in black gold paper. Then draw a square of one sq. *cun* with a blunt knife. The craftsman should hold his breath when he is picking up a piece of gold foil with a light stick wetted with his saliva and is clipping the foil between small pieces of paper. Apply the lacquer onto the surface before sticking gold foil onto it. In Shaanxi province, the people make "leather gold" by affixing gold leaves to sheepskin cured to an extreme thinness, so that it can be cut and made into articles of clothing or ornament, all of which gleam with golden splendor. When articles coated with gold leaves become worn, the gold should be scraped off and burnt, so that the gold is preserved in the ashes. A few drops of clear oil can be added to the ash for settling the gold, which is then re-



【原文】

用，皆煌煌至色存焉。凡金箔粘物，他日敝弃之时，削刮火化，其金仍藏灰内。滴清油数点，伴落聚底，淘洗入炉，毫厘无恙。

凡假借金色者，杭扇以银箔为质，红花子油刷盖，向火熏成。广南货物以蝉蛻壳调水描画，向火一微炙而就，非真金色也。其金成器物，呈分浅淡者，以黄矾涂染，炭木乍炙，即成赤宝色。然风尘逐渐淡去，见火又即还原耳。（黄矾详《燔石》卷。）

银

凡银中国所出，浙江、福建旧有坑场，国初或采或闭。江西饶、信、瑞三郡有坑从未开。湖广则出辰州，贵州则出铜仁，河南则宜阳赵保山、永宁秋树坡、卢氏高咀儿、嵩县马槽山，与四川会川密勒山、甘肃大黄山等，皆称美矿。其他难以枚举。然生气有限。每

【今译】

仍残留在灰内。滴上几滴菜子油，金质又聚积在下面，淘洗后再熔炼，一点都不会损失。

使器物具有金色的方法：杭州扇子是以银箔为材料，用红花子油刷涂，用火熏成。广南的货物则以蝉蛻壳碎粉调水来描图，用火稍微一烤而成。这些都不是真金的颜色。即令用金做成的器物，因成色不足而呈浅色时，也可用黄矾涂染，用炭火烘烤，立即就会变成赤金色。只不过日久因风尘作用，颜色又逐渐淡了下去，见火后又还原为原来的颜色。（关于黄矾，详见《燔石》章。）

银

中国产银的地方，在浙江、福建旧时有坑场，本朝初期，有的开采，有的关闭。江西饶州、广信和瑞州三处有银矿坑，但从未开采。湖南辰州出银，贵州出于铜仁，河南宜阳的赵保山、永宁的秋树坡、卢氏的高咀儿、嵩县的马槽山，以及四川会川的密勒山、甘肃大黄山等地，都是产银的美矿。其他地方难以枚举。然而经营的规模有限，很不景气。每次开采若产量不足，还不够偿付搜括与加派下来的苛捐



claimed through washing and smelting.

Make articles which look golden as follows: use silver foil as base, on which safflower seed oil is painted and then heated near a fire. In Guangdong Province, the articles are painted with a liquid by soaking the skins of cicadas in water, and then held briefly over a fire. However, these are not the true color of gold. Dye the light golden articles made of gold of low purity with yellow alum and then boil them with a charcoal fire so that they will soon present the color of pure gold. After a long time, however, the color will fade because of a certain amount of exposure. They will change to the original color after reheating. (For yellow vitriol, see Chapter 11.)

Silver

Silver deposits are found in many provinces of China. Some mines in Zhejiang and Fujian provinces, for example, were still yielding up to the early years of the era of the Ming Dynasty; though some others were shut down. There are also silver mines in Raozhou, Guangxin and Ruizhou in Jiangxi Province, but they are not being mined. Other rich mines are found in Chenzhou in Hunan province, Tongren in Guizhou Province, Zhaobaoshan, Qiushupo, Gaoju'er and Macaoshan in Henan Province, Milesan in Sichuan province, and Dahuangshan in Gansu Province, together with others which can not be all enumerated. But none of these are operating on a scale that is large enough to yield a profit. As a matter of fact, the production is often even not enough to compensate for duties, taxes or charges of many other kinds. Riots resulting from thefts would ensue if the mining laws are not strict. Therefore, unrelenting enforcement of prohibitions of mining laws has been necessary. In the cold provinces such as Hebei and Shandong, where



【原文】

逢开采，数不足则括派以赔偿。法不严则窃争而酿乱，故禁戒不得不苛。燕齐诸道则地气寒而石骨薄，不产金银。然合八省所生，不敌云南之半，故开矿、煎银唯滇中可永行也。

凡云南银矿，楚雄、永昌、大理为最盛，曲靖、姚安次之，镇沅又次之。凡石山洞中有矿砂，其上现磊然小石，微带褐色者，分丫成径路。采者穴土十丈或二十丈，工程不可日月计。寻见土内银苗，然后得礁砂所在。凡礁砂藏深土，如枝分派别。各人随苗分径横挖而寻之。上横板架顶以防崩压。采工篝灯逐径施镢，得矿方止。凡土内银苗或有黄色碎石，或土隙石缝有乱丝形状，此即去矿不远矣。

凡成银者曰礁，至碎者曰砂，其面分丫若枝形者曰钹，其外包环石块曰矿。矿石大者如斗，小者如拳，为弃置无用物。其礁砂形如煤炭，底衬石而不甚黑。其高下有数等（商民凿穴得砂，先呈官府验辨，然后定税）。出土以斗量，付与冶工。高者六七两一斗，中者三四两，最

【今译】

杂税。如果法制不严，盗矿而引起的争讼就会酿成祸乱，因之禁令也就越来越苛刻。河北、山东各省地气寒而矿层薄，不产金银。然而总计以上八省所出之银，尚不敌云南一半，所以开矿、炼银只有在云南可以长期持续下去。

云南银矿中以楚雄、永昌、大理为最盛，曲靖、姚安次之，镇沅又次之。石山洞中有银矿砂，其上出现一些堆积起来的小石，微带褐色，矿藏分成枝杈般的矿脉。采矿者挖土十丈或二十丈，工程不能以日、月计算。找到土内的银矿苗后，便知道礁砂之所在。礁砂都藏在深土中，像树枝那样分布。各个人沿着银矿脉走向分头挖进。坑道内要横架木板支撑洞顶，以防塌方。采矿工点灯沿矿脉挥锄挖掘，得矿方止。土内的银苗有黄色碎石，或土石缝内有乱丝形状的东西，这就说明离银矿不远了。

能炼出银的矿石叫礁，其中细碎的叫砂，表面分成树枝形的叫钹，包在外面的石块叫矿，大块的有斗那样大，小的像拳头大，都是废弃无用之物。礁砂的形状像煤炭，下面是一些石头而颜色不很黑。礁砂分高低几等（商民挖穴取礁砂，先交官府检验、辨别，然后定税）。取出的土以斗计量，交给冶炼工。品位高的一斗可炼出六七两银，中等



deposits are sparse, neither gold nor silver is mined. Now, the yields of silver from the above-mentioned eight provinces put together are less than half as much as that from Yunnan province, which is why sustained mining and smelting are possible there.

Of all the silver mines in Yunan Province, those in Chuxiong, Yongchang, and Dali rank the first, followed by those in Qujing and Yao'an; and lastly by those in Zhenyuan. The silver ore is usually found in stone caves, veined like branches and twigs with grayish particles of rock piled up on the top. It takes 10 to 20 *zhang* of digging and a lot of months before these branch-patterned ores can be extracted from the depths of the earth. Mining is done with each miner digging where a branch of the vein leads. Tunnels are propped up by wood boards to prevent cave-in. Miners dig their way in under lamp lights until they get the ores. Yellowish gravel or patterns in the cracks of the rock and earth that resembles entangled and twisted filaments are the usual indicators that tell them they are not far from what they are working for.

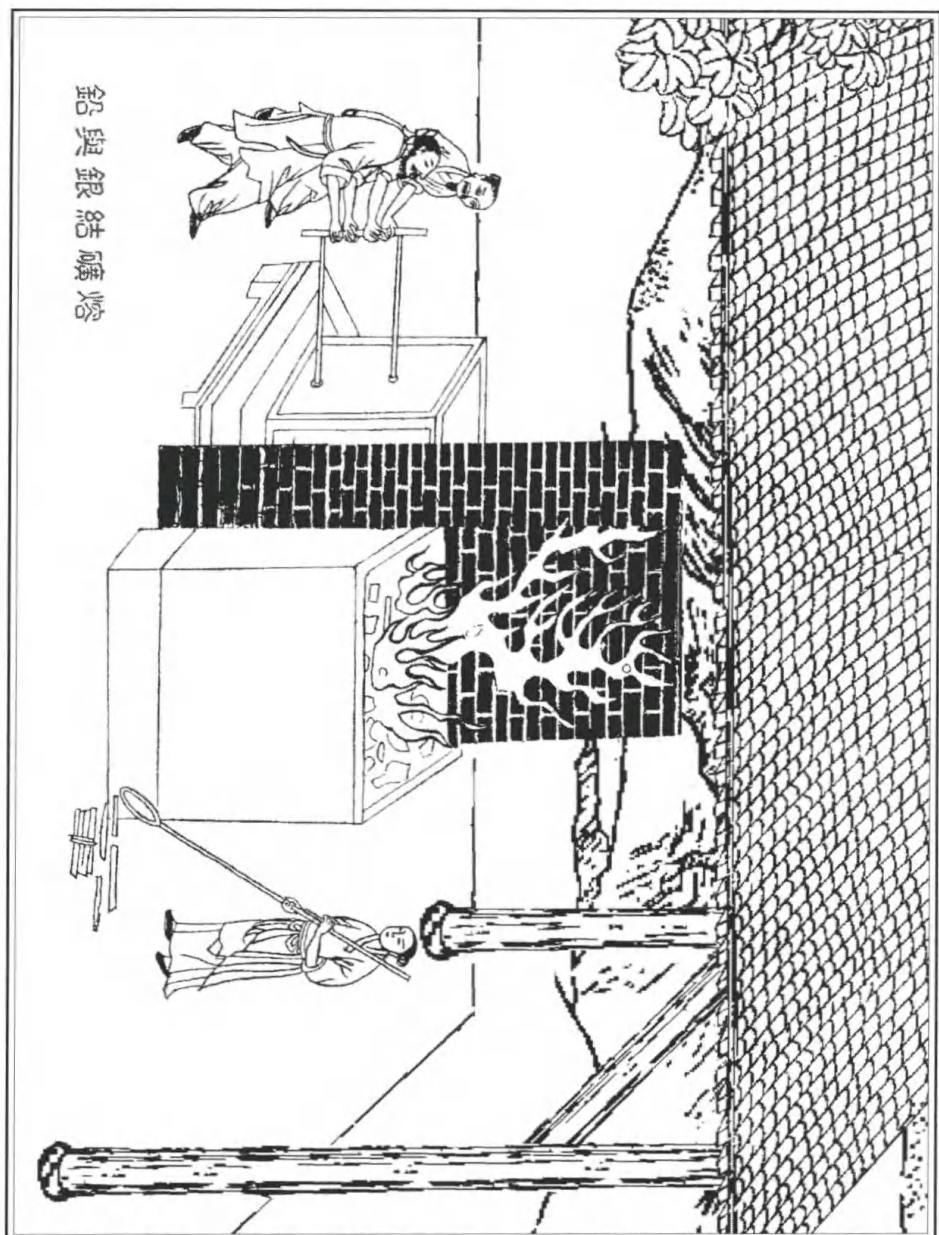
Silver ore that is rich enough to be commercially valuable is called *jiao* (reef or lode); the crushed ore is called *sha* (gravel), ore that has branch-like markings on its surface is called *kuang* (argentite -Ag₂S) and is usually surrounded by valueless boulders. The size of the boulders varies from that of a fist to a *dou*. The lode and gravel ore have the appearance of rocks beneath a coal seam but are not very dark in color. Ores are graded. (Grading is done at government agencies and taxes are levied according to the grading.) Excavated ores go to ore processors. High-grade ores yield 6 to 7 *liang* of silver per *dou*; less fine ones 3 to 4 *liang*; and the lowest-grade ones only 1 or 2 *liang* (the shining ores are of very low grade and yield very little silver).



開采銀礦



开采银矿
Mining silver ore



鉛與銀結礦熔

熔矿结银与铅
Smelting silver ore



【原文】

下一二两（其礁砂放光甚者，精华泄露，得银偏少）。

凡礁砂入炉，先行拣净淘洗。其炉土筑巨墩，高五尺许，底铺瓷屑、炭灰。每炉受礁砂二石，用栗木炭二百斤周遭丛架。靠炉砌砖墙一朵，高阔皆丈余。风箱安置墙背，合两三人力带拽透管通风。用墙以抵炎热，鼓鞴之人方克安身。炭尽之时，以长铁叉添入。风火力到，礁砂熔化成团。此时银隐铅中，尚未出脱。计礁砂二石熔出团约重百斤。

冷定取出，另入分金炉（一名虾蟆炉）内，用松木炭匝围，透一门以辨火色。其炉或施风箱，或使交箒。火热功到，铅沉下为底子（其底已成陀僧样，别入炉炼，又成扁担铅）。频以柳枝从门隙入内燃照，铅气净尽，则世宝凝然成象矣。此初出银亦名生银。倾定无丝纹，即再炼一火，当中只现一点圆星，滇人名曰茶经。逮后人铜少许，

【今译】

的得三四两，最下等的只得一二两（特别光亮的礁砂，品位不高，得银偏少）。

银矿砂入炉前，要首先拣净淘洗。炼银的炉子是用土筑成的，土墩高约五尺，底部铺上瓷屑、木炭。每炉装礁砂二石，用栗木炭二百斤在周围堆架起来。靠近炉旁砌一垛砖墙，高和宽都是一丈多。将风箱安置在墙背，由二三人拉动风箱通过风管送风。用墙挡住炉的高温，鼓风的人才能安身。炉内木炭烧完时，用长铁叉再将木炭添入。风力、火力足时，礁砂熔化成团，此时银隐藏在铅中，尚未脱离出来。共计礁砂二石可熔出团块约一百斤。

熔炉冷却后，将物料取出另装入分金炉（一名虾蟆炉）内，用松木炭在炉内围起，留出一穴门以辨火候。分金炉用风箱或用团扇送风，到一定温度，铅便沉下成为底子（炉底的铅成为密陀僧形状，另入熔炉冶炼，又成为扁担铅）。要不断用柳枝从穴门缝中插入燃烧，待铅的成分去尽后，便提炼成纯银了。刚炼出来的银叫生银。倒出来凝固后如果没有丝纹，便要再熔炼一次，这时在其中可看到一点圆星，云南人叫做“茶经”。此后向其中加入少许铜，重新用铅来协助熔化，然后放入槽中凝结成丝状。云南楚雄所产银矿有所不同，其中含铅甚少，



Unwanted particles in silver ore should be washed off before the ore is put in an earthen furnace. The kiln sits on a five-*chi*-tall earthen base. The bottom of the kiln is covered with crushed porcelain and charcoal. A typical oven has room for two *dan* of ore. It is then surrounded by a pile of chestnut wood to sustain the fire with. A brick wall, one *zhang* tall and one *zhang* long, is built at the back of the oven, behind which is a set of bellows. Two to three men work the bellows to blow air into the oven, which is why the wall needs to be built: to protect them from the heat. A long iron shaft with a loop on one end is used to collect burnt-out charcoal from the oven and refill it. The ore melts down to approximately 100 *jin* of lead-silver alloy lumps when the oven is adequately ventilated and heated.

The molten lumps are allowed to cool before they are taken out of the oven. They are then put into the separator (nicknamed toad oven). Pine wood charcoal is laid against the walls inside the separator, which has an opening through which the workers observe the fire. Air is blown or fanned into the oven until the temperature is right for the lead to sink (the litharge lead formed on the bottom of the furnace can be reconverted into lead by treating it in another furnace). Meanwhile, willow twigs are extended into the furnace every now and then to help the fire until the silver is all separated from the lead. The silver extracted this way is called raw silver. Smelting is required one more time when crude silver congeals into smooth-surfaced blocks. A second smelting gives the silver a round spot on its surface, which the Yunnanese call *chajing*. After that, a little copper is added to the silver and lead is used to help smelt the silver a third time. Molten silver is then poured into a mold to obtain the fine-ribbed pattern on its surface. Silver ore mined in Chuxiong of Yunnan province is different. The lead content in the ore is so low that



【原文】

重以铅力熔化，然后入槽成丝。其楚雄所出又异，彼铜砂铅气甚少，向诸郡购铅佐炼。每礁百斤先坐铅二百斤于炉内，然后煽炼成团。其再入虾蟆炉沉铅结银，则同法也。此世宝所生，更无别出。方书、本草无端妄想、妄注，可厌之甚。

大抵坤元精气，出金之所三百里无银，出银之所三百里无金。造物之情亦大可见。其贱役扫刷泥尘，入水漂淘而煎者，名曰淘厘镕。一日功劳，轻者可获三分，重者倍之。其银俱日用剪、斧口中委余，或鞋底粘带布于衢市。或院宇扫屑弃于河沿，其中必有焉，非浅浮土面能生此物也。

凡银为世用，唯红铜与铅两物可杂入成伪。然当其合琐碎而成钹，去疵伪而造精纯。高炉火中，坩埚足炼，撒硝少许，而铜、铅尽滞坩底，名曰银锈。其灰池中敲落者名曰炉底。将锈与底同入分金炉内，填火土甑之中，其铅先化，就低溢流，而铜与粘带余银用铁条逼就分拨，井然不紊。人工、天工亦见一斑云。

【今译】

必须从各地购入铅以助熔炼。每炼含银的矿砂一百斤，先将铅二百斤放在炉的底部，然后鼓风将其熔炼成团，再放入分金炉中，使铅沉下而结出银，与上述方法是一样的。银就是用这种方法炼出的，此外再没有别的方法。炼丹术方书和本草书没有根据地乱想、妄注，可厌之甚。

在大地里所含的矿藏中，出金之处三百里内无银，出银之所三百里内无金。大自然的情况，于此可见大概。有时仆役将扫刷的泥尘聚起，入水中淘洗，再煎炼出银，名曰淘厘镕。用一天的功夫，少者可得银三分，多者加倍。其所得的银，都来自日常用的剪子、斧子刃部掉下的残屑，或鞋底在闹市上粘带的土，或院内房内打扫下来的尘土抛弃在河沿，其中必杂有银质，这并不是说浅浮的土面上能生出银来。

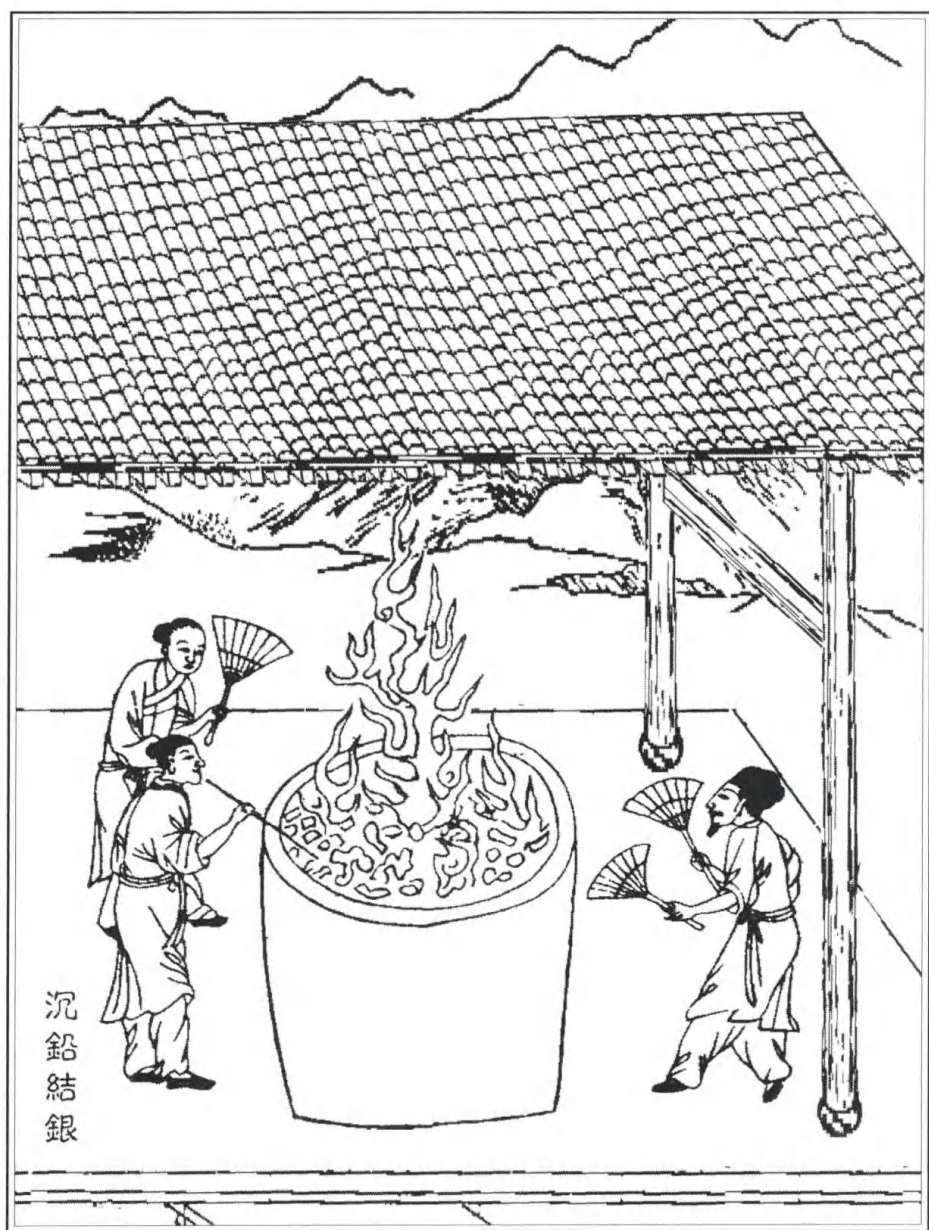
世上所用的银，只有红铜与铅两物可掺杂在其中作伪。但将碎银熔合成银锭时，可除去掺杂的东西而制成纯银。方法是将其放在坩埚中用高温炉火充分熔炼，撒入少量硝石，则铜与铅都沉在坩底，名曰银锈。从灰池中敲落下来的叫做炉底。将银锈与炉底一同放入分金炉内，将木炭填入土制的甑中点火，其中的铅先行熔化，流向低处，而铜与剩下的银粘带在一起，可用铁条拨离开来，两者截然分离。人力与自然力作用的相辅相成，由此可见一斑。



the lead has to be bought from other provinces to be mixed with the ore for processing. For every hundred *jin* of ore, 200 *jin* of lead is placed on the bottom of the kiln. This lead is melted down and mixed with the molten ore. The mixture is then put into a separating oven for the lead to settle and removed from the silver in the same way as described above. This is how silver is extracted from ore and there is no other way. The baseless conjectures and annotations in the alchemists' and naturalists' books are therefore very objectionable indeed.

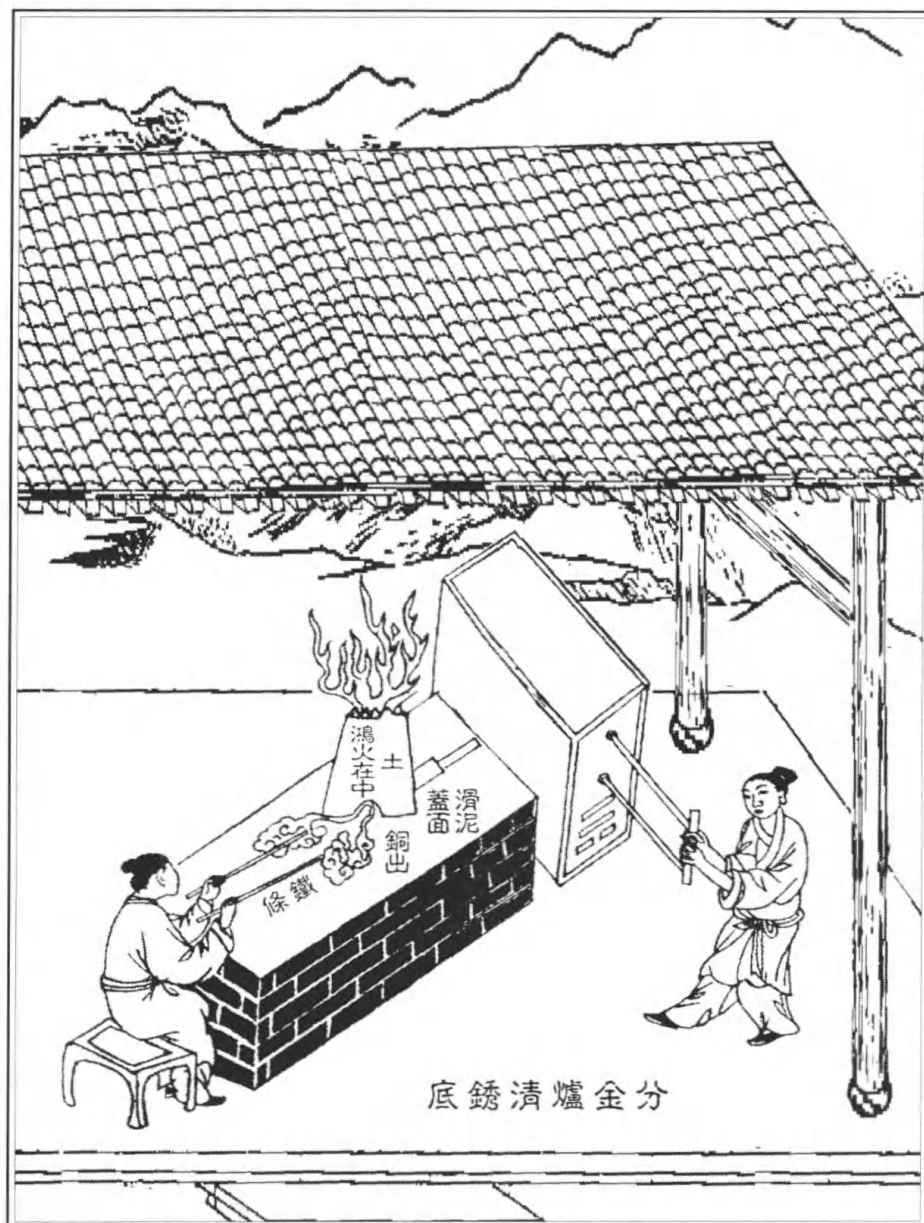
We gain a glimpse of Nature's way in the fact that gold and silver aren't found within 300 *li* of each other. As to the "panned particles" obtained by the laborers who wash the sweepings of dust and rubbish with water and then refine them with fire, thus getting between 3 and 6 *fen* of silver after spending a day at it, they are in fact the bits sheared off scissors and axes, stuck to the bottoms of shoes and thence mixed with dust and are found in street or household sweeping or in refuse along river banks. Silver isn't produced in the surface layer of the earth.

There is only one way of counterfeiting in silver production, and that is by mixing red copper and lead with silver. Unwanted elements can be removed by melting down the impure silver in a crucible together with saltpeter. This allows copper and lead to deposit at the bottom. Place the copper, lead and silver mixed with lead in the furnace. Put charcoal in the earthen furnace to break down the three elements. The lead melts first and flows down to the bottom. The copper and silver stay together on top. Use an iron stick to separate the silver from the copper. Both the force of nature and force of man have a part to play in obtaining silver.



沉铅结银

Separating lead from silver



分金炉清锈底

Refining silver



【原文】

附：朱砂银

凡虚伪方士以炉火惑人者，唯朱砂银愚人易惑。其法以投铅、朱砂与白银等分，入罐封固，温养三七日后，砂盗银气，煎成至宝。拣出其银，形存神丧，块然枯物。入铅煎时，逐火轻折，再经数火，毫忽无存。折去砂价、炭资，愚者贪惑犹不解，并记于此。

铜

凡铜供世用，出山与出炉只有赤铜。以炉甘石或倭铅掺和，转色为黄铜。以砒霜等药制炼为白铜。矾、硝等药制炼为青铜。广锡掺和为响铜，倭铅和泻为铸铜。初质则一味红铜而已。

凡铜坑所在有之。《山海经》言，出铜之山四百六十七，或有所考据也。今中国供用者，西自四川、贵州为最盛。东南间自海舶来，湖广武昌、江西广信皆饶洞穴。其衡、瑞等郡出最下品，曰蒙山铜者，或入冶铸混入，不堪升炼成坚质也。

【今译】

附：朱砂银

虚伪的炼丹术士利用炉火之术来迷惑人，只有朱砂银最容易愚弄人。其制造方法是，将铅、朱砂与等量的白银放入坩埚内密封，加热二十一日后，朱砂吸取银气，炼成为“银”。将这种“银”拣出一看，外表像银而无银的本质，只是废物一块。加入铅与其煎炼时，越炼越减重，再炼几次，竟完全消失。损失朱砂与木炭的资财，愚者贪心受惑尚不解此理，特记于此。

铜

供世上所用的铜，不管采自山上或出自冶炉，只有红铜一种。铜与炉甘石或锌掺和熔炼则转变颜色成为黄铜。铜与砒霜等制炼则成为白铜。铜与矾石、硝石等制炼又成为青铜。铜与广锡共炼则成为响铜，与锌共炼则得铸铜。但最基本的原料只是一种红铜而已。

铜坑到处都有。《山海经》说：出铜之山有四百六十七处，这或许是有根据的。今中国供人使用的铜，西部以四川、贵州出产最多，东南各省则间有借海船从国外输入的，武昌、江西广信都有不少铜矿。衡州、瑞州等地所出产的品位最低的所谓蒙山铜，或可在冶铸时掺入，不能单独冶炼成硬质铜。



Supplement: Cinnabar Silver

Dishonest alchemists use the furnace to counterfeit cinnabar silver to deceive other people. They put equal shares of lead, cinnabar and silver into a crucible and seal it up. After they are heated for twenty-one days, the cinnabar absorbs something from the silver and becomes the so-called silver. The cinnabar just looks like silver, yet it is not the silver obtained from nature. If lead is heated together with cinnabar, cinnabar becomes lighter. However, if it is heated several times, it disappears. Greedy people waste cinnabar and charcoal, and they don't know why.

Copper

Copper, whether obtained from mining or from the smelting process, is in the category of red copper. Mix copper with smithsonite or zinc, and brass is formed; with arsenic and other drugs, white copper; with alum and niter, blue (or aluminum) bronze; with tin from South China, bronze; with zinc, casting brass. All these alloys are derived from red copper.

Copper mines are found everywhere. According to *Shanhaijing*, there were 467 copper-producing mountains in China. This is probably true. Most of the commercially mined copper is from Sichuan and Guizhou provinces. In Southeast China, the domestic supply is supplemented by imports from abroad transported by sea vessels. Copper is also mined in Wuchang, Huguang and Guangxin, Jiangxi. Low-content ore from Hengzhou and Ruizhou is also used, but it is only added to the richer ore for smelting and is never processed alone for hard copper.



【原文】

凡出铜山夹土带石，穴凿数丈得之，仍有矿包其外，矿状如礞石而有铜星，亦名铜璞，煎炼仍有铜流出，不似银矿之为弃物。凡铜砂在矿内形状不一，或大或小，或光或暗，或如铊石，或如礞石。淘洗去土滓，然后入炉煎炼，其熏蒸旁溢者为自然铜，亦曰石髓铅。

凡铜质有数种，有全体皆铜，不夹铅、银者，洪炉单炼而成。有与铅共体者，其煎炼炉法，旁通高低二孔，铅质先化从上孔流出，铜质后化从下孔流出。东夷铜有托体银矿内者，入炉煎炼时，银结于面，铜沉于下。商舶漂入中国，名曰日本铜，其形为方长板条。漳郡人得之，有以炉再炼，取出零银，然后泻成薄饼，如川铜一样货卖者。

凡红铜升黄色为锤锻用者，用自来风煤炭（此煤碎如粉，泥糊作饼，不用鼓风，通红则自昼达夜。江西则产袁郡及新喻邑）百斤，灼于炉内。以

【今译】

出铜的山总是夹土带石的，挖数丈深即可见包在外面的脉石。这种石形状像礞石，而有铜星，亦名铜璞，冶炼后仍有铜流出，不像银矿的脉石那样被抛弃掉。铜砂在脉石里的形状不一，或大或小，或光或暗，有的像铊石，有的像礞石。土滓淘洗掉以后，将其入炉冶炼，经熔炼从炉旁流出的是自然铜，也叫石髓铅。

铜矿有数种，有全体都是铜而不夹杂铅、银的，在熔炉中一炼即成。有与铅共生在一起的，这种铜矿的冶炼方法是，在熔炉旁边开高、低两个孔，铅先熔化从上孔流出，后熔化的铜从下孔流出。日本国的铜有包在银矿的脉石中的，入炉熔炼时银出现在上面，而铜沉于下。由商船运入中国，名曰日本铜，其形状为长方形板条。福建漳州人得到这种铜后，有的入炉再炼，提出其中夹杂的银，再将铜熔成薄饼形状，像川铜一样地出售。

将红铜炼成可锤锻的黄铜，要用一百斤自来风煤炭（这是粉状碎煤，和泥做成煤饼，燃烧时不需鼓风，烧起来昼夜通红。在江西产于袁州府及新喻县）放入炉内燃烧。用泥瓦罐装十斤铜，再装入六斤炉甘石，置于



Where there is copper in a mountain, the earth's surface is often covered by a mixture of dirt and stones. The ore is mined through a shaft several *zhang* deep. The run-of-the-mine copper ore is encased in boulders shaped like ginger-root. Specks of copper are also present in these boulders, unlike those found around silver ore, and can also be smelted for copper. The copper ores within the boulders are of various sizes and shapes—some shiny, some dull, some resemble brass, while others are like ginger-shaped iron. Copper ore is washed to eliminate earth particles before it is smelted. When it is heated in the furnace, what melts and flows out is the natural copper or stone marrow lead.

There are different kinds of copper ores. Some do not contain lead or silver and are easy to smelt. In other ores, copper is bonded with lead. These ores are fed into a furnace with two openings in the side, one above the other. Molten lead comes out of the higher opening at lower temperatures before copper melts and is collected from the lower opening. Japan produces an ore that contains both copper and silver. During the smelting process, copper melts and settles on the bottom of the furnace, while silver rests on the top of the molten material. The Japanese copper ore is imported to China in the shape of rectangular sheets. The imported copper is often reprocessed in Zhangzhou in Fujian Province to obtain the silver in it. Then the smelters shape the reprocessed copper into thin cakes and sell them just as they sell the Sichuan-made copper.

To convert copper into brass, one hundred *jin* of “self-bellowing coal.” is used (this kind of coal is found in powder form and is made into “coal cakes” by mixing it with some mud. They can burn all day without the use of a bellow. It is made in Yuanzhou Prefecture and Xinyu Country in Jiangxi province). Put ten



穴取铜铅

Digging a shaft to get copper and lead ores



淘淨銅砂 化銅

Smelting an ore containing both copper and lead
Molten lead and copper flowing out from two separate holes



【原文】

泥瓦罐载铜十斤，继入炉甘石六斤，坐于炉内，自然熔化。后人因炉甘石烟洪飞损，改用倭铅。每红铜六斤，入倭铅四斤，先后入罐熔化。冷定取出，即成黄铜，唯人打造。

凡用铜造响器，用出山广锡无铅气者入内。钲（今名锣）、鐃（今名铜鼓）之类，皆红铜八斤，入广锡二斤。铙、钹，铜与锡更加精炼。凡铸器，低者红铜、倭铅均平分两，甚至铅六铜四。高者名三火黄铜、四火熟铜，则铜七而铅三也。

凡造低伪银者，唯本色红铜可入。一受倭铅、砒、矾等气，则永不和合。然铜入银内，使白质顿成红色，洪炉再鼓，则清浊浮沉立分，至于净尽云。

附：倭铅

凡倭铅，古书本无之，乃近世所立名色。其质用炉甘石熬炼而成，繁产山西太行山一带，而荆、衡为次之。每炉甘石十斤装载入

【今译】

炉内，原料自然会熔化。后来人们鉴于炉甘石烟飞时有耗损，遂改用锌。每红铜六斤，加入锌四斤，先后入罐熔化。冷却后取出，即成为黄铜，任人打造成各种器物。

用铜制乐器时，将矿山出产的不含铅的两广产的锡与铜同入炉内熔炼。制造钲、鐃之类乐器，一般是用红铜八斤，加入广锡二斤。制铙、钹所用的铜和锡，要求更加精炼。制造供冶铸用的铜器物时，质低的铜器含红铜和锌各一半，甚至含锌十分之六而铜十分之四。高质量的铜器则用三次或四次精炼的所谓三火黄铜、四火熟铜作原料，其中含铜十分之七、锌十分之三。

制造假银的，只有纯粹红铜可以掺入。银遇到锌、砒、矾等物，永远不能结合。然而将铜混入到银中，白色的银立刻变成红色，再入炉内鼓风，则银、铜间的清浊、浮沉立见分明，以至于彻底分离。

附：倭铅

倭铅（锌）在古书中本无记载，乃是近世所制订的名称。此物由炉甘石烧炼而成，盛产于山西太行山一带，而荆州、衡州次之。每



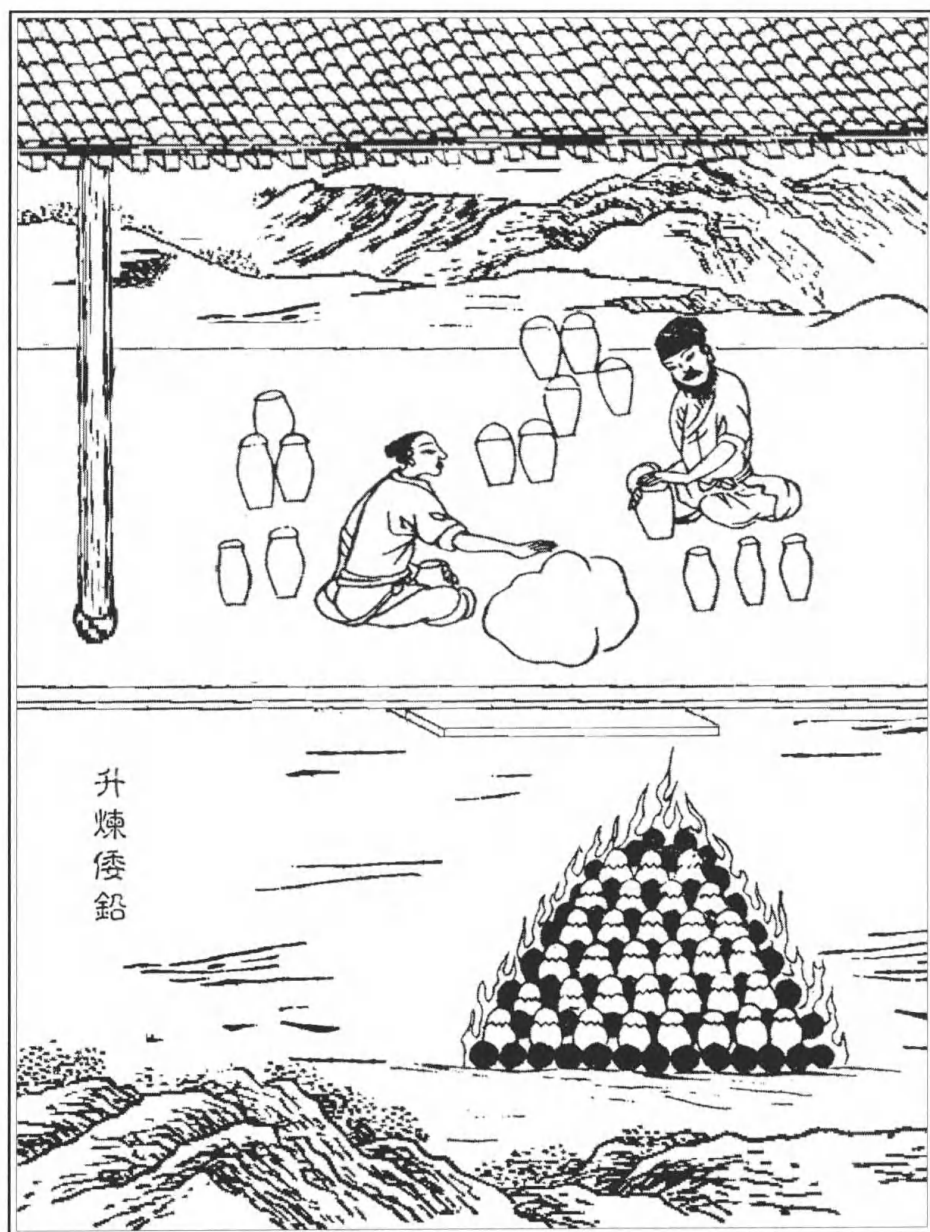
jin of copper in an earthen pot and add six *jin* of smithsonite and then put them into the furnace. The copper will melt. Smithsonite, in the process of disintegration, evaporates away, so zinc is used to replace smithsonite. Six *jin* of copper, with four *jin* of zinc, are put into an earthen pot to smelt. The copper turns into brass after cooling and people can make various kinds of utensils with this kind of brass.

To make bronze musical instruments with copper, copper is smelted together with lead-free tin produced in Guangdong and Guangxi. The ratio between copper and tin varies depending on what instruments are made. For bronze bells, for example, it is eight to two. More refined ingredients are required for making such musical instruments as *nao*. In casting bronze instruments, the percentages of bronze and tin should be equal. The best-quality products require copper that has gone through three to four smelting procedures and is mixed with zinc to the ratio seven to three.

Forging involves mixing copper with silver. Silver never combines with zinc, arsenic or vitriol, but it does combine with copper. In this case, silver loses its bright luster and turns red. Melting the mixture helps separate copper from silver.

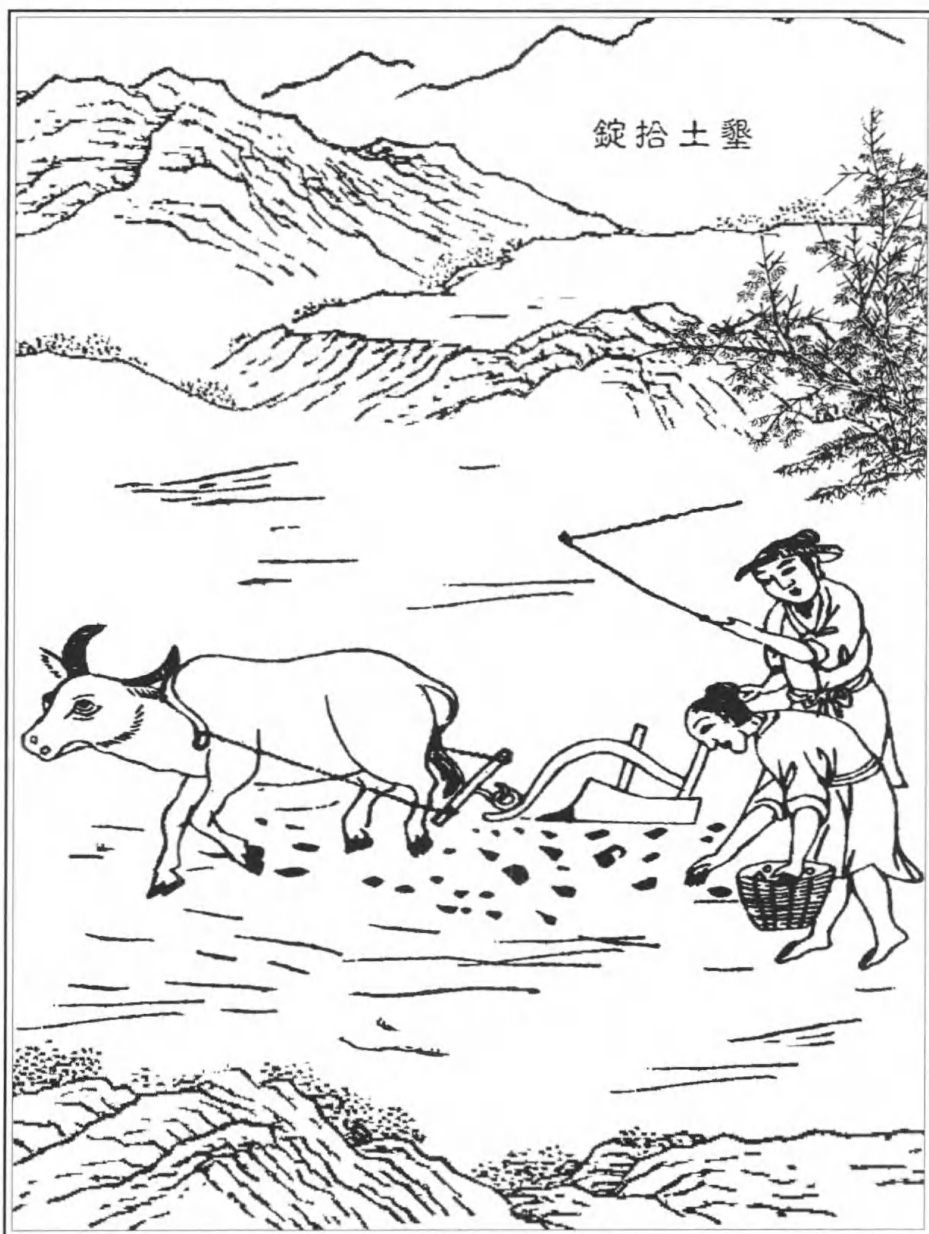
Supplement: Zinc

Zinc (also called Japanese lead) is a recent-coined word that was not recorded in ancient books. It is extracted from calamine. The Taihangshan Mountains in Shanxi Province is the top producer of zinc, followed by Jingzhou and Hengzhou. To produce zinc, put ten *jin* of calamine in an earthen jar. Seal it tightly with mud and smooth the exterior. The jar is then allowed to dry. Caution must be taken to keep it away from fire lest the heat cracks the mud exterior. When the jars are ready, coal



炼锌

Smelting zinc ore in earthen jars



耕土拾鋤

Ploughing up pieces of iron ore



【原文】

一泥罐内，封裹泥固，以渐研干，勿使见火拆裂。然后逐层用煤炭饼垫盛，其底铺薪，发火煨红。罐中炉甘石熔化成团，冷定毁罐取出，每十耗去其二，即倭铅也。此物无铜收伏，入火即成烟飞去。以其似铅而性猛，故名之曰倭云。

铁

凡铁场所在有之，其质浅浮土面，不生深穴。繁生平阳岗埠，不生峻岭高山。质有土锭、碎砂数种。凡土锭铁，土面浮出黑块，形似秤锤。遥望宛然如铁，拈之则碎土。若起冶煎炼，浮者拾之，又乘雨湿之后牛耕起土，拾其数寸土内者。耕垦之后，其块逐日生长，愈用不穷。西北甘肃、东南泉郡皆锭铁之藪也。燕京、遵化与山西平阳则皆砂铁之藪也。凡砂铁，一抛土膜即现其形，取来淘洗。入炉煎炼，熔化之后与锭铁无二也。

凡铁分生、熟，出炉未炒则生，既炒则熟。生熟相合，炼成则钢。凡铁炉用盐做造，和泥砌成。其炉多傍山穴为之，或用巨木匡

【今译】

次将炉甘石十斤装入泥罐内，用泥包裹、封固，再将表面碾光滑，让它慢慢风干，切勿见火，以防拆裂。然后逐层用煤饼将泥罐垫起，其下面铺柴，引火烧红。罐中的炉甘石熔化成团，冷却后毁罐取出，就是锌。每十斤炉甘石要耗损二斤。此物如果不用铜结合，入火就变成烟飞去。因其很像铅而性质又比铅猛烈，故称之为倭铅。

铁

铁矿到处都有，浅浮在地面，不生于深穴，而繁生于平坦、向阳的高岗上，不生于高山峻岭。矿质有土锭铁、砂铁等数种。土锭铁是地表浮出的黑块，形状像秤锤。远处看上去像是铁，但用手一捻则成碎土。若打算冶炼，则将浮在地表的矿石拾起，又乘雨湿之后用牛犁起浅土，拾取数寸深以内的土。土地经耕后，铁块还会逐日生长，用之不竭。西北的甘肃、东南的泉州，都是土锭铁的聚集处。燕京、遵化与山西平阳，又都是砂铁的集中产地。砂铁一破开表土就会看到，取来淘洗。再入炉冶炼，熔化之后与锭铁相同。

铁分生铁、熟铁，出炉后未经炒过的是生铁，炒过的是熟铁。生铁与熟铁混合一起熔炼后，便成为钢。炼铁炉用盐和泥砌成，多设



cakes together with firewood are piled up underneath them to make a fire. The molten material inside the jars is allowed to cool for the zinc to take shape. The jars are then broken in order to get the metal out. Every ten *jīn* of calamine produces eight *jīn* of zinc. This metal is easily burnt off by fire if not mixed with copper. Because it is similar to lead, yet fiercer in nature, so it is called zinc.

Iron

Iron deposits are found everywhere in near-to-surface depths and south-facing slopes of highlands and are never buried deep in elevated rocky mountains. Iron ore comes in lumps and the granular form. The ore lumps can be found right on the surface of the soil and has a shape resembling the sliding weight of a steelyard. The lumps look like iron, but will disintegrate at the touch like a clod of earth. Those on the surface of the soil can be picked up for smelting and refining. Sometimes ore collectors need to go a few *cun* deep. In this case they plow the ground after a rainy day to get the ore from the moist soil. Deposits develop under plowed ground so that there is always ore supply. Ore lumps are primarily mined in Gansu Province in the northwest and Quanzhou in the southeast of China. The iron ore of the granular form is collected in Yanjing, Zunhua and Pingyang in Shanxi Province. The iron ore of the granular form becomes observable when its earth coating is partly removed. When the ore is washed and smelted in a furnace, the resulting iron is the same as that processed from the lump ore.

There are two types of iron. One is pig iron, and the other is wrought iron. The former is the direct product of a blast furnace, while the latter is made from further treatment of pig iron. Steel is produced by refining a mixture of both pig and wrought iron. A furnace is built



【原文】

围，塑造盐泥，穷月之力，不容造次。盐泥有罅，尽弃全功。凡铁一炉，载土二千余斤，或用硬木柴，或用煤炭，或用木炭，南北各从利便。扇炉风箱必用四人、六人带拽。土化成铁之后，从炉腰孔流出。炉孔先用泥塞。每旦昼六时，一时出铁一陀。既出即叉泥塞，鼓风再熔。

凡造生铁为冶铸用者，就此流成长条、圆块，范内取用。若造熟铁，则生铁流出时相连数尺内、低下数寸筑一方塘，短墙抵之。其铁流入塘内，数人执持柳木棍排立墙上。先以污潮泥晒干，舂筛细罗如面，一人疾手撒揅，众人柳棍疾搅，即时炒成熟铁。其柳棍每炒一次，烧折二三寸，再用则又更之。炒过稍冷之时，或有就塘内斩划成方块者，或有提出挥椎打圆后货者。若浏阳诸冶，不知出此也。

凡钢铁炼法，用熟铁打成薄片如指头阔，长寸半许。以铁片束包夹紧，生铁安置其上（广南铁名堕子生铁者，妙甚），又用破草履（粘带

【今译】

在靠近矿山附近，或用巨木围成框，用盐泥塑造成炉，要用一个月的功夫建成，不可匆忙从事。如果盐泥有裂缝，则前功尽弃。炼一炉铁要装入二千余斤铁矿土，燃料用硬木柴，或用煤炭，或用木炭，南北各地因地制宜。向炉内鼓风的风箱，必须由四人或六人共同推拉。矿土熔化成铁水后，从炉腰的孔中流出。炉孔事先用泥塞住。每日白天六个时辰中，一个时辰出一陀铁。出一次铁后，立刻叉上泥将出铁孔塞住，再鼓风熔炼。

生产供铸造用的生铁，便让铁水流到条状或圆块状的型模中，再从模子里取出使用。若造熟铁，则在生铁水流出几尺远而低几寸的地方，筑一个方形的塘，塘边砌一低墙，让铁水流入方塘内，数人持柳木棍并立在墙上。事先将黑色的湿泥晒干，捣碎并用细罗筛成面粉状的细面。一人迅速将泥面撒在铁水中，其余众人用柳棍急忙搅拌，生铁即刻便炒成熟铁。柳棍每炒一次，要烧损二三寸，用过几次再更换新的。炒过后稍微冷却时，或者就地在方塘内将铁水切划成方块，或者提出来捶打成圆饼，然后出售。但像湖南浏阳那些冶铁场还不懂得这种方法。

炼钢铁的方法是，先将熟铁打成薄片，像指头一样宽，长约一寸半。然后用铁片包扎紧，将生铁放在扎紧的熟铁片上面（广东南部有一



with salt-reinforced clay, usually near the mine. Sometimes logs are used to form a frame around the furnace. It takes one month to build a furnace. There must be no hurry, otherwise the clay may crack and it will have to be done all over again. A furnace should have the capacity for over 2,000 *jin* of ore. Materials for fuel vary from hard wood, coal to charcoal, depending on where the processing takes place. A gigantic bellow blows air into the furnace, and it takes four to six people to work it until the molten iron flows from an outlet in the middle of the furnace wall. The outlet is blocked by clay until the ore is melted. A complete day and night is divided into six equal periods. The melted lumps of iron flow out every two hours. The hole is blocked again until the next batch is ready.

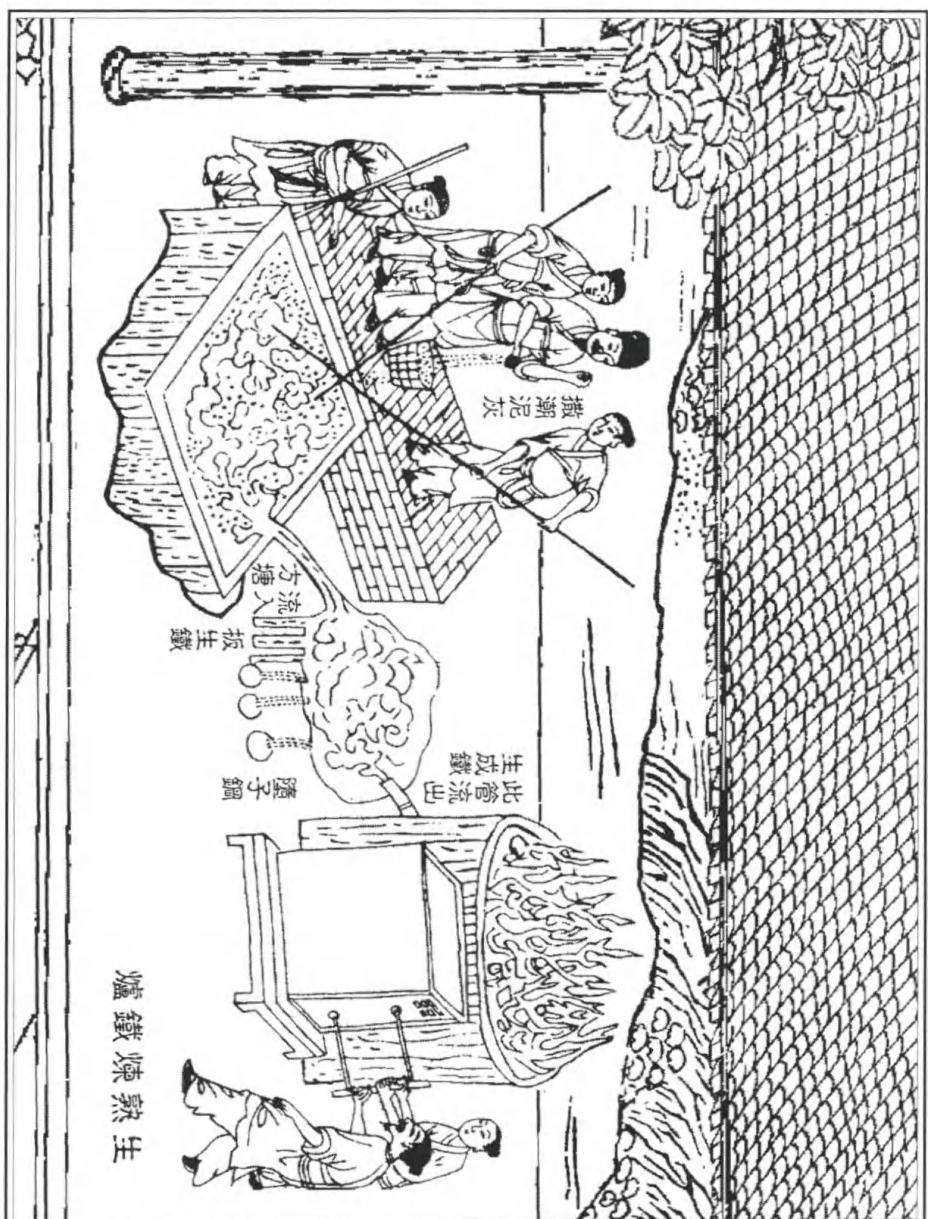
To produce cast iron, the melted iron is discharged into a bar or circle-shaped mold to cool. To produce wrought iron, a square pool is built a few *chi* away from and a few *cun* lower than the furnace. A short wall is built by the side of the pool. When melted iron gathers in the pool, workers sprinkle fine dust of dried black mud from the top of the wall over the pool while they keep stirring the iron liquid with willow sticks. This is how wrought iron is produced. Two or three *cun* of each willow stick will be burnt off at the end of each operation, so that new ones will have to be used at the next turn. When the wrought iron is cooled a little bit it is either cut into blocks in the pool or taken out to be beaten into cakes for sale. Iron producers in Liuyang, in Hunan Province, don't know about this technique yet.

To make steel, wrought iron is hammered into thin pieces about a finger wide and one and a half *cun* long. These pieces (There is a kind of pig iron in Guangdong Province which is called the "pendulum-shaped iron") are then wrapped tightly with iron sheets. Next, the pig iron is placed on the



淘洗铁砂

Concentrating iron ore by washing



生熟煉鐵爐

生熟煉鐵爐

Smelting iron ore to make pig iron and wrought iron



【原文】

泥土者，故不速化）盖其上，泥涂其底下。洪炉鼓鞴，火力到时生铁先化，渗淋熟铁之中，两情投合。取出加锤，再炼再锤，不一而足。俗名团钢，亦曰灌钢者是也。

其倭夷刀剑有百炼精纯，置日光檐下则满室辉曜者。不用生熟相合炼，又名此钢为下乘云。夷人又有以地搜淬刀剑者，云钢可切玉，亦未之见也。凡铁内有硬处不可打者，名铁核，以香油涂之即散。凡产铁之阴，其阳出慈石，第有数处，不尽然也。

锡

凡锡，中国偏出西南郡邑，东北寡生。古书名锡为“贺”者，以临贺郡产锡最盛而得名也。今衣被天下者，独广西南丹、河池二州居

【今译】

种生铁，叫堕子生铁，最好用），再用破草鞋（用粘带有泥土的，不致很快烧毁）覆盖在最上面，铁片下面涂以泥浆。再放入熔炉内鼓风，火力到时生铁先化成铁水，渗淋到熟铁之中，使生铁、熟铁二者相互结合。自炉中取出后锤打，反复锤打，不一而足。这样得到的产物俗名叫团钢，也叫做灌钢。

日本国的刀剑用百炼精纯的钢，白天放在屋檐日光下则满室生辉、光耀夺目。这种钢不是用生铁与熟铁合起来冶炼的，也有人说此钢是下品。外国人又有用地搜为刀剑淬火的，据说这种钢可以切玉，但我未曾见过。铁内有一种硬质而无法锻打，叫做铁核。如果上面涂上香油，再打就可打散。要是铁矿产于山的背阴处，其向阳的山坡便出磁铁矿石，不过也有些地方不尽如此。

锡

锡在中国的分布偏于西南各地，东北很少。古书中将锡称为“贺”，因为临贺县产锡最盛，故而得此名。现在供应全国的锡，单是广西南丹、河池这两个州就占十分之八，衡州、永州次之，云南的大



top, which is covered with worn straw sandals (preferably those with mud on them to prevent them from being burned). Then a paste of mud is applied to the bottom of the iron sheets. The combination of these ingredients is then put in the blast furnace. When the temperature is right, the pig iron melts first and permeates the wrought iron pieces to make an alloy. The mixture is then taken out for pounding that goes on for various lengths of time. The end product is known as permeated steel.

The Japanese make their knives and swords with fine steel that goes through multiple smeltings, even one hundred times. Their swords are so bright that sunlight shines off them enough to light up the whole room. The steel is not produced with a combination of pig iron and wrought iron. Some say this is low quality. In some countries crude oil is used for austempering steel swords. Steel processed this way is said to be hard enough to cut jade, but I have never seen this done. Iron contains particles called iron core in it that are too hard for the beating process. An application of sesame oil to the surface solves the problem. Where iron ore is found on the northern side of mountains, there are usually magnetic deposits on the southern side. But there have been exceptions to this observation.

Tin

Tin is found in many places in the southwestern provinces and in very few places in the northeastern part of China. Tin is referred to as “*he*” in ancient books, so named after the county *Linhe* where it abounds. Eighty percent of tin supply now comes from Nandan and Hechi in Guangxi. Hengzhou and Yongzhou are the second top suppliers. Tin ore is also found often in Dali and Chuxiong in Yunnan Province, but low accessibility to these frontier places makes trans-



【原文】

其十八，衡、永则次之。大理、楚雄即产锡甚盛，道远难致也。

凡锡有山锡、水锡两种，山锡中又有锡瓜、锡砂两种。锡瓜块大如小瓠，锡砂如豆粒，皆穴土不甚深而得之，间或土中生脉充牣，致山土自颓，恣人拾取者。水锡，衡、永出溪中，广西则出南丹州河内。其质黑色，粉碎如重罗面。南丹河出者，居民旬前从南淘至北，旬后又从北淘至南。愈经淘取，其砂日长，百年不竭。但一日功劳，淘取煎炼，不过一斤。会计炉炭资本，所获不多也。南丹山锡出山之阴，其方无水淘洗，则接连百竹为枳，从山阳枳水淘洗土滓，然后入炉。

凡煎炼亦用洪炉，入砂数百斤，丛架木炭亦数百斤，鼓鞴熔化。火力已到，砂不即熔，用铅少许勾引，方始沛然流注。或有用人家炒锡剩灰勾引者，其炉底炭末、瓷灰铺作平池，旁安铁管小槽道，熔时

【今译】

理、楚雄虽然产锡甚多，但路途遥远，难以运输。

锡有山锡、水锡两种，山锡中又有锡瓜、锡砂两种。锡瓜块大如小葫芦，锡砂像豆粒，都是挖土不甚深便可得到。有时土中矿脉充斥，便从山土下落，任人拾取。水锡出于衡州、永州的小河中，广西则产于南丹州境内的河中。其质地为黑色粉状，像用罗筛过的面似的。南丹河里所产的水锡，居民在前十天从南淘到北，后十天又从北淘向南。越是淘取，砂锡越是日渐生长，百年不竭。但劳累一天，淘洗、熔炼后不过得一斤锡。再将炉炭成本计算在内的话，所获利润并不多。南丹山锡产于山的背阴，其地无水淘洗，可用许多竹筒接成水槽，从山的阳坡引水淘洗土滓，然后入炉。

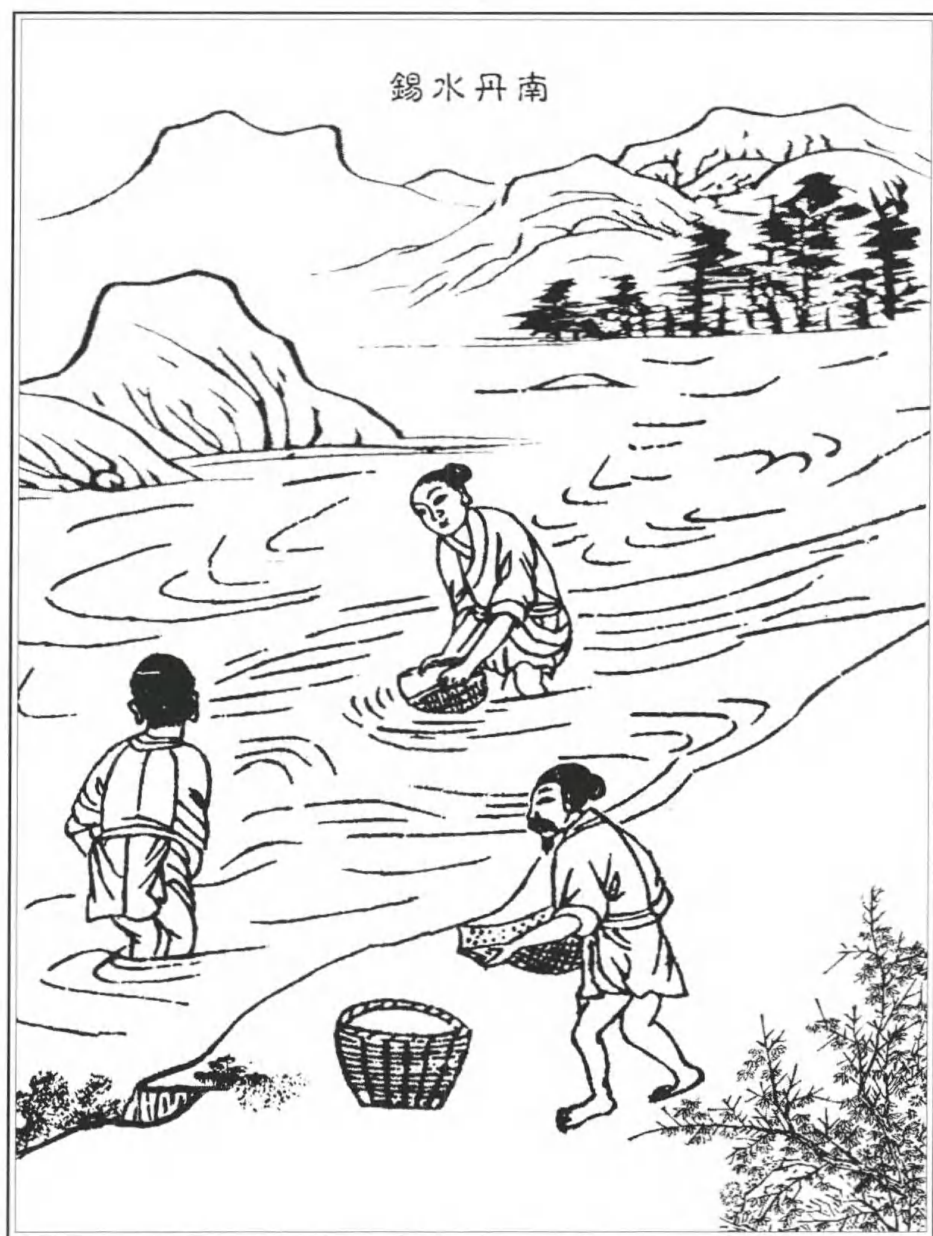
炼锡时也用洪炉，炉内装入锡砂数百斤，堆架起来的木炭也用数百斤，鼓风熔炼。火力到时，如锡砂还不能立刻熔化，就要投入少量铅作引子，锡才开始顺畅地流出。也有用别处炼锡时剩下的炉渣作引子的，此时炉底下用炭末、瓷器粉末铺成平池，旁边安装铁管作为小槽道，锡熔化时就会流出到炉外的低池内。锡刚出炉时颇



portation difficult.

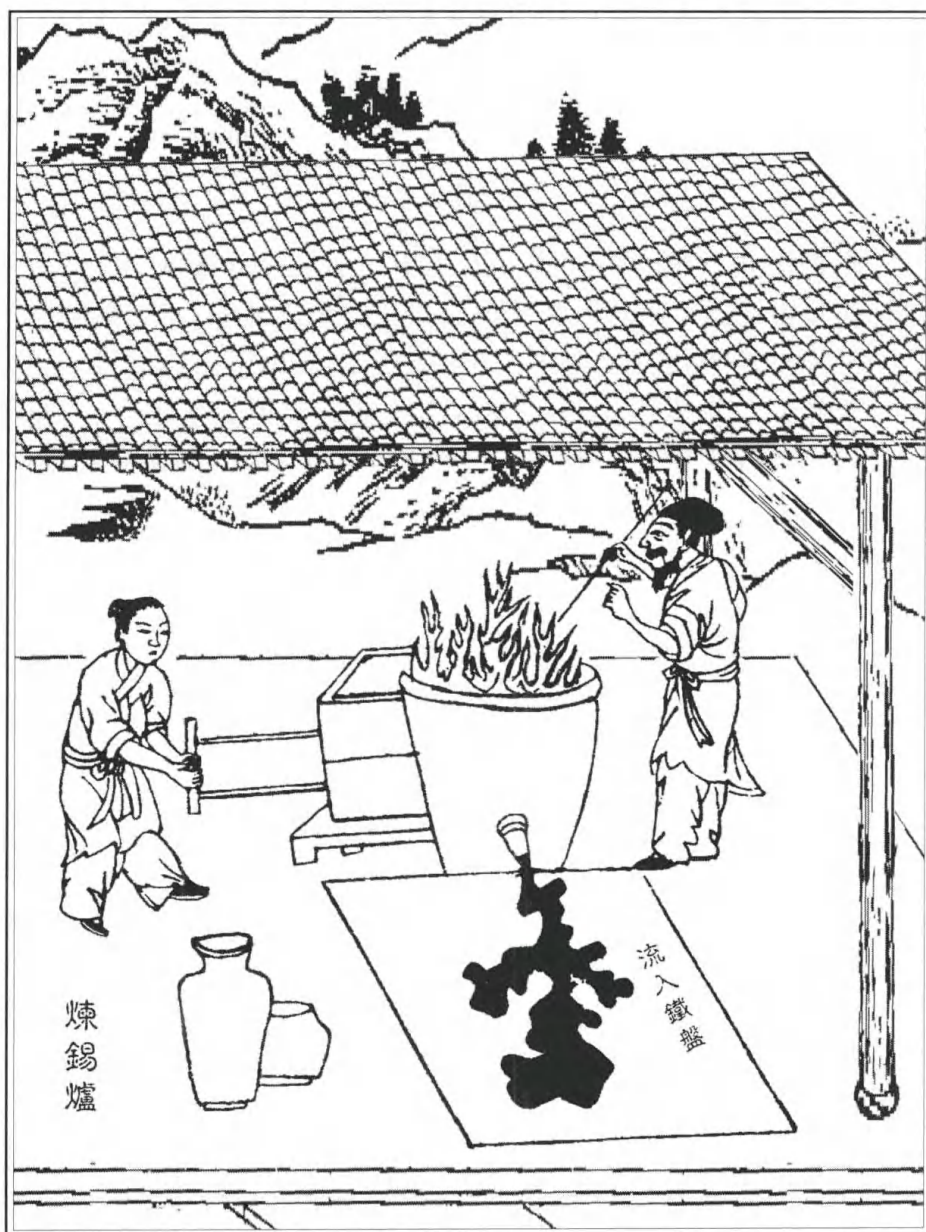
Tin ore is obtained both from mountainous places called “mountain tin” and from rivers called “stream tin”. Of those coming from mountains, some are of the size of gourds and others, grains. It requires only some easy digging to find both types of deposits. Where the soil contains an enormous number of veins, the ore drops off and is easily picked by the miners. Stream tin is mined from the small rivers of Hengzhou and Yongzhou and the rivers in Nandan. The deposits are like black dust, as fine as sieved flour. In the river of Nandan, the inhabitants recover the tin ore from the river by first working from the south northward, and then from the north southward alternately at ten-day intervals. Mining reveals more deposits so that mining can go on for hundreds of years without exhausting the supply. A day’s work of washing and smelting produces only one *jin* of tin. Taking into account the cost of the fuel for the furnace, the profit is little. In the mountains of Nandan, where tin ore is mined from the northern side of the mountains, bamboo pipes are connected to form a water slot for the washing process. Water is channeled from the southern side. The unwanted particles are washed off the ore, which is then smelted in a furnace.

A blast furnace is used for smelting tin ore as well. A batch of hundreds of *jin* of tin ore takes an equal amount of charcoal. When there is not enough heat to melt the ore, a small amount of lead can be added. This creates an alloy that has a lower melting point. The molten material then is discharged out of the furnace. Sometimes, instead of lead, the residue waste of refined tin is used for this purpose. The bottom of the furnace is leveled out with charcoal ash or crushed porcelain. An iron pipe channels the molten material out into a low pool. When tin first comes out of the furnace, the metallic tin, being pure



南丹水錫

Recovering tin ore from rivers at Nandan, Guangxi



煉錫爐

Smelting tin ore by adding lead



【原文】

流出炉外低池。其质初出洁白，然过刚，承锤即拆裂。入铅制柔，方充造器用。售者杂铅太多，欲取净则熔化，入醋淬八九度，铅尽化灰而去。出锡唯此道。方书云马齿苋取草锡者，妄言也。谓砒为锡苗者，亦妄言也。

铅

凡产铅山穴，繁于铜、锡。其质有三种，一出银矿中，包孕白银，初炼和银成团，再炼脱银沉底，曰银矿铅，此铅云南为盛。一出铜矿中，入洪炉炼化，铅先出，铜后随，曰铜山铅，此铅贵州为盛。一出单生铅穴，取者穴山石，挟油灯寻脉，曲折如采银矿。取出淘洗、煎炼，名曰草节铅，此铅蜀中嘉、利等州为盛。其余雅州出钓脚铅，形如皂荚子，又如蝌蚪子，生山涧沙中。广信郡上饶、饶郡乐平

【今译】

色洁白，然而太脆，一锤打便要破裂。向锡中加入铅才能使其变柔，这样才能用来制造器物。卖锡的人在其中掺杂的铅太多，要想提纯，便将其熔化后放入醋中淬八九次，铅便会化成灰而除去。生产锡只有这个方法。炼丹术著作中说，从马齿苋可取得草锡，这是荒诞的说法。所谓砒是锡矿苗的说法，也是荒诞的。

铅

产铅的矿山比产铜、锡的还多。铅矿有三种，一种出于银矿脉石中，含有银，初炼时与银在一起成团块。再炼时铅与银分离而沉在炉底，叫银矿铅；这种铅在云南最多。另一种出于铜矿脉石中，入炉熔炼后，铅先流出，随后流出铜，叫铜山铅，贵州产得最多。另一种铅出于单独的铅矿，采矿者挖山石、提油灯寻找矿脉，此矿脉像银矿脉那样曲折。采出后便淘洗、熔炼，得到的是草节铅。这种铅在四川嘉州、利州出产最多。其他还有雅州出产的钓脚铅，形状像皂荚子，又



white in color, is very brittle and breaks into pieces when hammered. Some lead must be added to soften it so that it can be used for making various utensils. If tin objects bought in the shops contain too much lead and purification is desired, these objects should be soaked in vinegar and let boil eight or nine times, so that the lead can be eliminated. The process described above is the only way of producing tin. The alchemists' books mention obtaining "grass tin" from the grass *Portulaca oleracea*. This is nonsense. The notion that arsenic is the outcropping of tin is also a mistake.

Lead

There are more lead mines than there are copper or tin. Three types of lead deposits are commercially mined. One is called silver lead. It contains silver ore. It takes two smeltings to separate these metallic elements. Most silver lead ores are mined in Yunnan Province. Another type of lead is found in copper veins. In the smelting process, lead melts first and flows out of the furnace. Lead extracted this way is called copper lead. Most copper lead is produced in Guizhou Province. The third type of lead exists in high purity. Miners dig into the gravelled earth in search for the veins which are twisted and crooked just like the silver veins. They use oil lamps to light up the tunnels. Ore obtained this way goes through the washing and smelting processes. The end product is PbS (grass-joint lead). Jiazhou and Lizhou in Sichuan Province are the biggest producers. Yazhou, in Sichuan Province, produces another kind that looks like bean pods or tadpoles. This is made from ore obtained from the sandy bottoms of mountain streams. Shangrao and Leping in Jiangxi province produce lead that contains copper. Jianzhou in Sichuan province produces "Yiping lead". Many



【原文】

出杂铜铅，剑州出阴平铅，难以枚举。

凡银矿中铅，炼铅成底，炼底复成铅（图8-2）。草节铅单入洪炉煎炼，炉旁通管，注入长条土槽内，俗名扁担铅，亦曰出山铅，所以别于凡银炉内频经煎炼者。凡铅物值虽贱，变化殊奇。白粉、黄丹皆其显象。操银底于精纯，勾锡成其柔软，皆铅力也。

附：胡粉、黄丹

凡造胡粉，每铅百斤，熔化，削成薄片，卷作筒，安木甑内。甑下、甑中各安醋一瓶，外以盐泥固济，纸糊甑缝。安火四两，养之七日。期足启开。铅片皆生霜粉，扫入水缸内。未生霜者，入甑依旧再养七日，再扫，以质尽为度。其不尽者留作黄丹料。

每扫下霜一斤，入豆粉二两、蛤粉四两，缸内搅匀，澄去清水。用细灰按成沟，纸隔数层，置粉于上。将干，截成瓦形，或如磊块，

【今译】

像蝌蚪子，出于山涧的砂中。江西广信府上饶、饶州府乐平出杂铜铅，剑州出阴平铅，产地难以枚举。

提炼银矿中的铅，方法是，熔炼银矿，银流出后铅便沉在炉底，再熔炼炉底物料，才得到铅。草节铅则一次入炉熔炼，炉旁通一管，以便将铅水注入长条形土槽内，所得到的铅叫扁担铅，又叫出山铅，以别于在炼银炉内多次熔炼出的铅。铅价值虽便宜，其变化却很是奇特。白粉、黄丹都是铅变化成的。使银炼得精纯，令锡变得柔软，都靠铅的作用。

附：胡粉、黄丹

造胡粉的方法是，每次用铅百斤熔化后削成薄片，卷成圆筒，放在木甑之中。甑的下部和中部各放醋一瓶。外面用盐泥封固，用纸将甑上的缝糊好，以四两木炭的火力保温七天。日子到时启开，铅片上布满霜粉，扫到水缸中。未生霜的铅片再入甑中，依旧加热七天，再扫下霜粉，直到铅尽为止。剩下的残渣留作制黄丹的原料。

每扫下一斤霜，加入豆粉二两、蛤粉四两，一同放入水缸内搅匀，澄清后倒去水。用细木炭粉做成沟，上面铺几层纸，将湿粉放在



other places produce various kinds of lead as well.

The method for extracting lead from silver ore involves melting the ore down so that silver flows out of the furnace first. Then the slag is smelted to separate lead from other materials. But PbS (grass-joint lead) takes only one smelting. A pipe is attached to the furnace to let lead out into a square pool. Lead produced this way is called carrying-pole lead or mined lead, to be distinguished from the byproduct of multiple smeltings in the silver furnace. Lead is cheap, but it combines with a lot of elements to make various compounds. White-lead powder and litharge are made out of lead. Silver is purified, and tin softened, with lead.

Supplement: White Lead and Litharge

To produce white lead, cut molten lead which weighs a hundred *jin*, into thin slices. Put cylinders rolled with the slices into a wooden container, the bottom and middle part of which each has a bottle of vinegar. The outside part of the container is sealed with salt mud. Paste the slots on the container with paper. Keep it warm for seven days with power from four *liang* of charcoal. Open the container when it is time. Sweep the powder which covers the lead slices into a vat. Put the lead slices into the container again and heat for another seven days. Collect the lead powder till all the lead slices are gone. The rest of the slag can be saved and used as material for producing red lead.

Two *liang* of bean powder and four *liang* of clam powder is added to every *jin* of lead frost. The mixture is then put into a jar of water and stirred well. After the powder settles, water is drained off. The wet dross is now laid down on layers of paper which have been placed on top of fine charcoal powder. As moisture is being absorbed by the pa-



【原文】

待干收货。此物古因辰、韶诸郡专造，故曰韶粉。今则各省直饶为之矣。其质入丹青，则白不减。擦妇人颊，能使本色转青。胡粉投入炭炉中，仍还熔化为铅。所谓色尽归皂者。

凡炒铅丹，用铅一斤、土硫黄十两、硝石一两。熔铅成汁，下醋点之。滚沸时下硫一块，少顷入硝少许，沸定再点醋，依前渐下硝、黄。待为末，则成丹矣。其胡粉残剩者，用硝石、矾石炒成丹，不复用醋也。欲丹还铅，用葱白汁拌黄丹慢炒，金汁出时，倾出即还铅矣。

【今译】

纸上，快吸干时切成瓦形或方块，待干时收起出售。因为古时辰州、韶州专造此物，故名韶粉。现在则各省都广为制造。用这种粉画画，则白色不退。但妇女用以擦脸，能使面色变青。将胡粉投入炭火炉中，仍还炼化为铅，这就是所谓物极必反，颜色白至极点就要变黑的道理。

烧制铅丹时，用铅一斤、土硫黄十两、硝石一两。先将铅熔化成液态，点上一些醋。滚沸时放入硫黄一块，稍过一会，再投入硝石少许，沸腾停止后再照前法点醋。逐步加硝石、硫黄。待物料都变成粉末，就说明黄丹已制成。残剩的胡粉，再用硝石、矾石炒成黄丹，不必再用醋。要想使黄丹还原为铅，用葱白汁伴黄丹慢炒，黄色液汁出现时，顷刻即还原为铅。



per, the dross forms a paste that is then cut into squares. These are dried and stored for future sale. Chenzhou and Shaozhou used to be the only producers of the powdered paste. Its name “shao powder” was named after Shaozhou. But today it is being produced in almost every province. When used in painting, the powder gives a permanent white tinge. But it turns the natural complexion greenish-sallow when used by women as a cosmetic powder. Fire turns it back to lead—an example of how everything reverts after reaching its uttermost.

Ingredients for making litharge include one *jin* of lead, ten *liang* of native sulphur and one *liang* of niter. First, the lead is melted. Some drops of vinegar are poured onto the molten lead. When the lead starts to boil, a piece of sulphur is added, followed by a small piece of niter. A little more vinegar is added when the boiling stops. Then a little more niter and sulphur are slowly added. Litharge is obtained when the mass turns into powder. If the residue left from making white lead is used as a raw material, the process consists of roasting it with niter and alum without vinegar. To convert litharge back into lead, heat the former over a slow fire with scallion-stalk juice. When the liquid turns yellow, pour it off. The remainder is lead.



冶铸第九

【原文】

宋子曰，首山之采，肇自轩辕，源流远矣哉。九牧贡金，用襄禹鼎。从此火金功用日异而月新矣。夫金之生也，以土为母。及其成形而效用于世也，母模子肖，亦犹是焉。精粗巨细之间，但见钝者司舂，利者司垦，薄其身以媒合水火而百姓繁。虚其腹以振荡空灵而八音起，愿者肖仙梵之身，而尘凡有至象。巧者夺上清之魄，而海寓遍流泉。即屈指唱筹，岂能悉数，要之人力不至于此。

鼎

凡铸鼎唐虞以前不可考。唯禹铸九鼎，则因九州贡赋壤则已成，

【今译】

宋子说，从黄帝时代便开始在首山采铜铸鼎，其源流已很久远了。夏禹时，九州的地方官进贡金属，以帮助禹王铸成大鼎。从那以后，借火力来冶铸金属的工艺便日新而月异地发展起来。金属产生于土，以土为母。当金属铸成器物而效用于世时，其形状与土制的模型相像，还是以土为母。铸件有精粗、大小的不同。但见钝的碓头用来舂捣，利的犁铧用以垦土；薄的铁锅可盛水、受火，而百姓广泛运用它们。中空的大钟用以振荡空气而生八音，信徒们仿拟仙佛之身在凡世间铸出极好的佛像。精巧的铜镜镜面光滑无比，可夺日月之辉，而金属铸币则通行于四海之内。诸如此类，屈指头、唱筹码怎能说尽？总之，人力能做到的还不止这些。

鼎

铸鼎的事，尧、舜以前已不可考。至于夏禹铸九鼎，则因九州纳



Chapter 9

Casting

Songzi says that ever since the time of the Yellow Emperor, copper mining and casting of three-legged tripod or four-legged cauldron for cooking have been conducted in Shoushan. In China, mining has had a very long history. In the time of Emperor Yu of the Xia Dynasty, metals were presented to the Emperor for his Great Tripod by the magistrates of the nine provinces. Ever since then, the craftsmanship of metal casting by fire improved with time. Metal is produced from earth when it is in its natural state. When it is made into implements for people, it is produced like earthen molds. The implements vary in quality and size. People use these implements widely: from one that is blunt as a mortar for pounding grains to one that is as sharp as a ploughshare for plowing to one as thin as an iron wok for containing water and cooking. A big bell is made from metal and made into a hollow shape which creates harmonious sounds that fill the air. Chiliasts create figures with metal so that the images of Buddha can be seen in this mortal world. The surface of an exquisite copper mirror can be glazed so that it will be even brighter than sunlight and moonlight. Metal coins are circulated throughout the country. The uses are so numerous that it is impossible to count them. On all accounts, human efforts can do more than these.

Casting of Tripods

There is no record of the casting of tripods before the time of



【原文】

人贡方物岁例已定，疏浚河道已通，《禹贡》业已成书。恐后世人君增赋重敛，后代侯国冒贡奇淫，后日治水之人不由其道，故铸之于鼎。不如书籍之易去，使有所遵守，不可移易，此九鼎所为铸也。

年代久远，末学寡闻，如螭珠、暨鱼、狐狸、织皮之类，皆其刻画于鼎上者，或漫灭改形亦未可知，陋者遂以为怪物。故《春秋传》有使知神奸、不逢魑魅之说也。此鼎入秦始亡，而春秋时郕大鼎、莒二方鼎，皆其列国自造，即有刻画，必失《禹贡》初旨。此但存名为古物，后世图籍繁多，百倍上古，亦不复铸鼎，特并志之。

【今译】

土地赋税法则已经制订，各地每年进贡方物条例已定，河道已经疏浚畅通，禹制订的九州贡法《禹贡》业已成书。禹王恐怕后世帝王增加赋税、加强搜括，后代各地诸侯以奇淫品冒充贡物，后世治水的人不按其方式行事，因此将这一切铸在鼎上，不像写在书上容易失去，使人们有所遵循，不轻易改变。这就是当时铸九鼎的原因。

过了很长年代，学问浅、见识少的人，见到刻画在鼎上的形象，如螭珠、暨鱼、狐狸、织皮之类，或许已经漫漶、脱落而变形，难以辨认为何物，无知者遂以为是怪物。因此《春秋左氏传》中才有关于禹鼎像物使老百姓识别神怪、避免魑魅伤害的说法。其实这些鼎至秦代就已散失了。而春秋时郕国的大鼎、莒国的两个方鼎，都是诸侯国自造，即使鼎上有些刻画，也必定失去《禹贡》的原意，只不过作为古物存其名而已。后世图书甚多，百倍于上古，亦用不到铸鼎。特附记之。



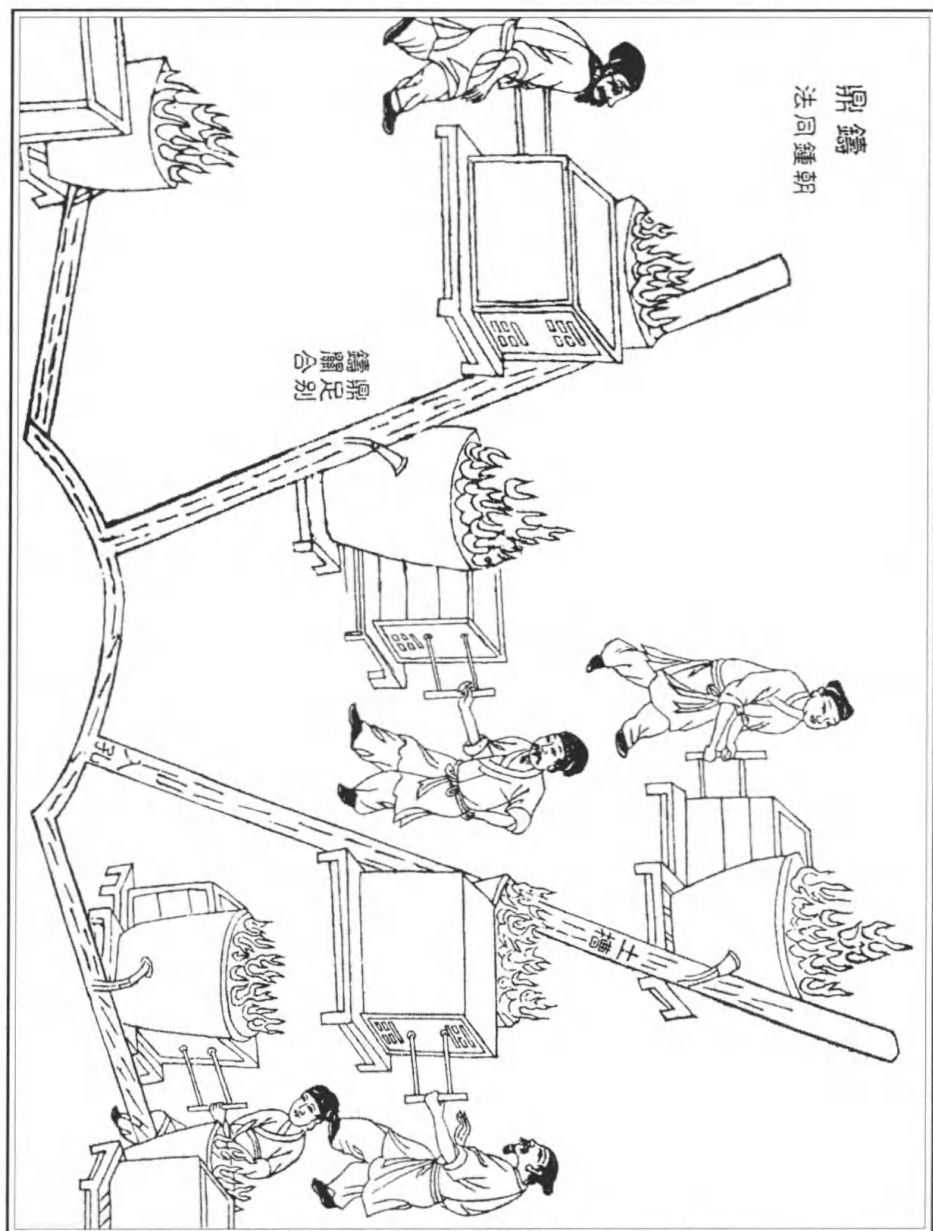
Emperor Yao and Emperor Shun. The casting of the nine tripods began when the laws of land taxes of the nine provinces had been enacted, the annual tribute statutes of every region had been fixed, the river courses had been dredged and the book *Tributes of Yu* written by Emperor Yu, had been finished. Worried that the rulers of future ages might increase the taxes and force tributes, that in the future the local governors might substitute tributes with extravagant articles, and that those who were in charge of the control of floods might not follow the correct methods, Emperor Yu ordered that all these regulations should be inscribed on tripods so that they might be more durable than books and would be impossible to change. That is the reason why the nine tripods were cast at that time.

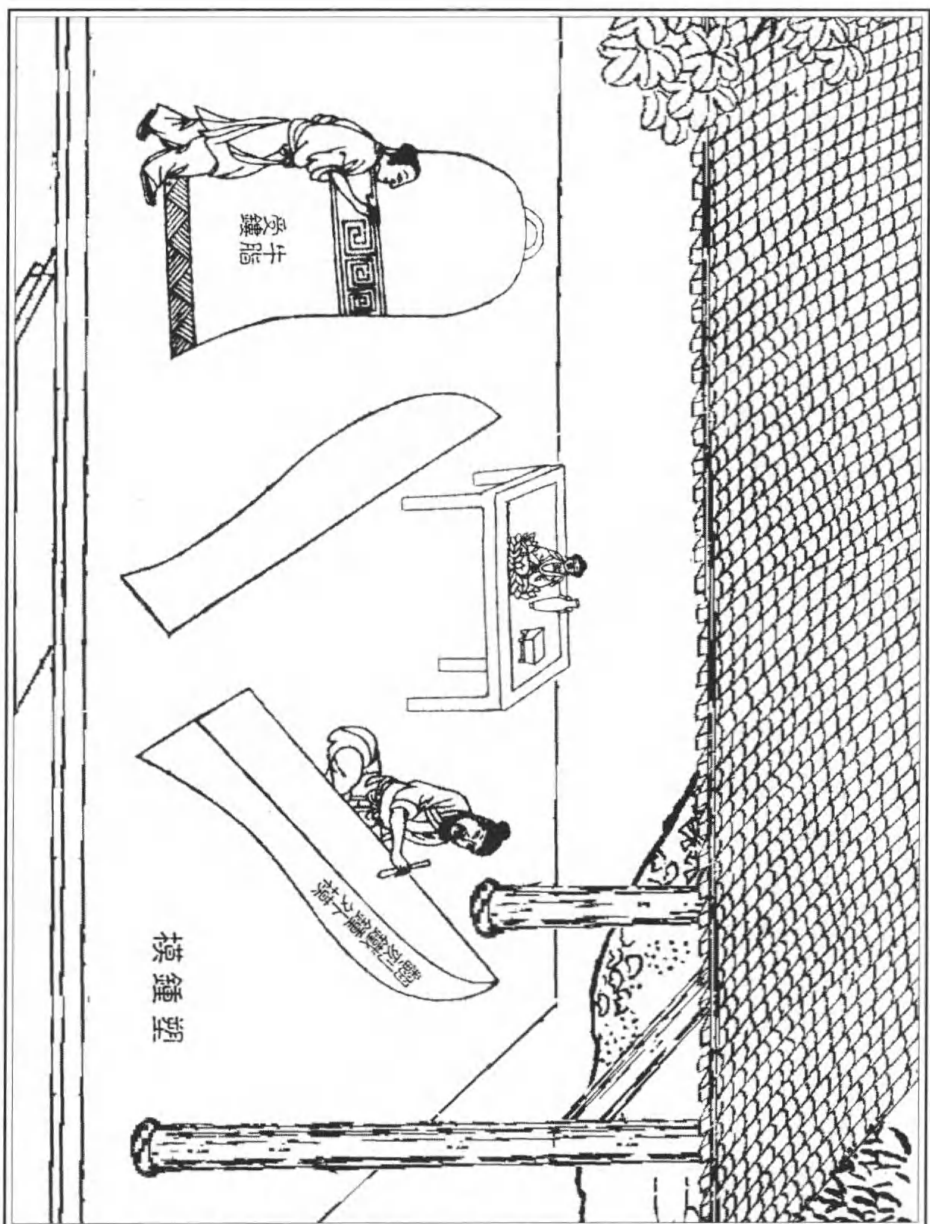
As the centuries passed people's knowledge about antiquity became unclear. It is said that such phrases as "pearls and fish" and "foxes and woven leather" were inscribed on the tripods, but the words might have been mutilated and worn by time. The ignorant, however, took these to be sentences denoting frightful phenomena, giving rise to the statement in the Spring and Autumn Chronicle that "if one knows the designs of the spirits then ghosts and monsters can be avoided." By the Qin Dynasty, the tripods of Yu had been lost. Although the Great Tripod of the state of Gao, and the two square tripods of the state of Ju, were cast in the Spring and Autumn Period, their inscriptions by no means had the same intent as those of *Tributes of Yu*; that is, these things were antiques in name only. Since in later times there have been a great number of documents and books, far more than those of ancient times, the casting of tripods became unnecessary. Here, therefore, the history of tripods is noted.



Casting a ten-thousand-jin tripod

铸鼎





塑鐘模
Mold for bell



【原文】

钟

凡钟为金乐之首，其声一宣，大者闻十里，小者亦及里之余。故君视朝、官出署，必用以集众。而乡饮酒礼，必用以和歌。梵宫仙殿，必用以明揖谒者之诚，幽起鬼神之敬。凡铸钟，高者铜质，下者铁质。今北极朝钟则纯用响铜，每口共费铜四万七千斤、锡四千斤、金五十两、银一百二十两于内。成器亦重二万斤，身高一丈一尺五寸，双龙蒲牢高二尺七寸，口径八尺，则今朝钟之制也。

凡造万钧钟，与铸鼎法同。掘坑深丈几尺，燥筑其中如房舍，埏泥作模骨。其模骨用石灰、三和土筑，不使有丝毫隙拆。干燥之后以牛油、黄蜡附其上数寸。油蜡分两，油居十八，蜡居十二。其上高蔽抵晴雨（夏月不可为，油不冻结）。油蜡埽定，然后雕镂书文、物象，丝发成就。然后舂筛绝细土与炭末为泥，涂埽以渐而加厚至数

【今译】

钟

钟是金属乐器之首，钟声一响，大者可在十里之外听到，小者也能传一里多远。所以皇帝临朝、官吏赴官署，必靠敲钟来聚集众人。举办各种官方宴会，必用编钟来伴奏。仙佛寺殿必以钟声打动参拜者的诚心，激起对鬼神的敬意。铸钟时，上等钟用铜，劣钟用铁为原料。今宫内北极阁朝钟则全用响铜铸造，每口钟共费铜四万七千斤、锡四千斤、金五十两、银一百二十两。铸成的钟重二万斤，身高一丈一尺五寸，钟上的双龙蒲牢高二尺七寸，钟直径八尺。这是现今朝钟的形制。

铸造万斤钟和铸鼎的方法相同。挖一丈多深的坑，使坑内保持干燥，并把它构筑成如房舍一样，和泥做内模。铸钟的内模用石灰、三和土做成，不使有丝毫裂隙。干燥之后，以牛油、黄蜡涂抹在上面约数寸厚。油、蜡配方是牛油占十分之八，黄蜡占十分之二。其上有高棚以遮挡日光和雨（夏天不操作，因为油不凝结）。油蜡涂固后，在上面雕刻文字、图案，细心操作。然后将捣碎并筛过的绝细土与炭粉调和成泥，逐层涂在油蜡上至数寸。使外模里外彻底干实，在外面用火力



Casting of Bells

A bell is the foremost of all metal musical instruments. A big ringing bell can be heard ten *li* away, and even a small one can be heard more than one *li* away. Therefore, bells are rung to assemble people when an emperor is holding court or when officials are summoned to their government offices. The ringing of serial chime bells must accompany an official banquet. Bells are rung to touch the heart-strings of worshippers and also to arouse their respect for gods. In the casting process, the material used for making high-quality bells is copper while that of low-quality bells is iron. Now in the North Star Pavilion in the palace, bell metal is used to make the Audience Bells each of which costs 47,000 *jin* of copper, 4,000 *jin* of tin, 50 *liang* of gold and 120 *liang* of silver. The finished bell weighs 20,000 *jin* and measures 1.15 *zhang* in height, with a diameter of 8 *chi*. The double-dragon “pulao” (a kind of sea animal, symbolizing the loudness of the bell) cast on the bell is 2.7 *chi* in height. These are the specifications of the Audience Bells used at the present time.

The method for casting a 10,000-*jin* bell is the same as that for a tripod. Dig a pit of one *zhang* deep and keep the inside dry. A house-like construction should be built inside the pit and an inner model should be made from a mixture of lime and mortar. Not a single crack is allowable. After it is dry, apply some ox fat and yellow wax several *cun* thick, the proportion being eight tenths of ox fat and two tenths of wax. The function of the tall canopy above is to protect the model from sunlight and rain (This should not be done in summer because oil does not congeal in summer time). Characters and images should be cast with great care after the oil wax becomes fixed. Next, very fine earth and charcoal



【原文】

寸。使其内外透体干坚，外施火力炙化其中油蜡，从口上孔隙熔流净尽，则其中空处即钟鼎托体之区也。

凡油蜡一斤虚位，填铜十斤。塑油时尽油十斤，则备铜百斤以俟之。中既空净，则议熔铜。凡火铜至万钧，非手足所能驱使。四面筑炉，四面泥作槽道，其道上口承接炉中，下口斜低以就钟鼎入铜孔，槽旁一齐红炭炽围。洪炉熔化时，决开槽梗（先泥土为梗塞住），一齐如水横流，从槽道中视注而下，钟鼎成矣。凡万钧铁钟与炉、釜，其法皆同，而塑法则由人省啬也。

若千斤以内者则不须如此劳费，但多捏十数锅炉。炉形如箕，铁条作骨，附泥做就。其下先以铁片圈简直透作两孔，以受杠穿。其炉垫于土墩之上，各炉一齐鼓鞴熔化，化后以两杠穿炉下，轻者两人，

【今译】

熔化其中油蜡，油蜡从铸模下部内外模交合的孔隙中熔流净尽。则内外模间的中空部分，就是以后铸出钟鼎形状的地方了。

流出一斤油蜡所空出的部分，可灌铸十斤铜。塑铸模时用十斤油，便要准备一百斤铜。模中油蜡流尽，就该熔铜。万斤的熔铜不是人手足所能驱使的。要在钟模四周筑熔炉并在四周用泥做槽道，槽道上端与熔炉出口相接，槽道下端向低倾斜以便与钟鼎浇铜口相接。槽道两旁用烧红炭火围起来保温。炉内铜熔化时，打开出铜水口的塞子（先用泥土为塞塞住），铜液像流水一样沿槽道向下注入模内，于是便铸成钟、鼎了。制万斤重的铁钟与香炉、大锅，其铸造方法皆与此相同。只是塑模的方法可由人们根据不同的条件与要求，适当地省略罢了。

至于铸造千斤以下的铸件，则不须如此劳费，只要多做十几个小炉就成。炉形状像簸箕，铁条作骨架，用泥做成。炉下两侧用铁片卷成的圆铁管穿透两个孔，以便承受穿过的抬杠。各炉都放在土墩之上，同时鼓风熔铜。熔化后，用两杠在炉下穿过，轻的二人，重的数



powder are pounded, and mixed into a mud paste, which is gradually spread on the surface of the engraved wax until it is several *chi* thick. When it is thoroughly dried, heat is applied from the outside so that the fat and wax will melt, and flow out entirely through apertures at the base. The bell or the tripod will then be cast in the cavity thus vacated between the core and mold.

The vacated part made by the one *jin* of oil wax can be filled with ten *jin* of copper. Therefore, when ten *jin* of oil is used to cast the model, one hundred *jin* of copper is needed. After all the oil wax in the model is drained, the next step should be the melting of copper. It is impossible for a man to manage the melting of ten thousand *jin* of copper only with his hands. A smelter should be built surrounding the bell mold and mud should be used to make troughs connecting with the smelter outlets. The bottom of a trough tilts downward so that it can be connected to the copper-casting orifice. Around the troughs a charcoal fire is lighted to keep warm. After the copper inside the smelter is melted, unplug the orifice which is plugged with clay. Then the liquid copper will flow along the troughs into the mold and then a bell or a tripod will be finished. The methods of casting an iron bell which weighs around ten thousand *jin*, a censer or a large cauldron are all similar to this. The only difference is the method for making a mold which can be altered according to certain conditions and requirements.

It won't take so many efforts, however, to cast something that weighs less than a thousand *jin*. All we need are a dozen more small clay smelters which look like dustpans and have iron bars for a framework. There are two holes made by round iron tubes at the bottom of the smelter to sustain the bar which runs through the smelter. Every smelter used to melt copper by blasting is built on a mound. After the



【原文】

重者数人抬起，倾注模底孔中。甲炉既倾，乙炉疾继之，丙炉又疾继之，其中自然黏合。若相承迂缓，则先入之质欲冻，后者不黏，衅所由生也。

凡铁钟模不重费油蜡者，先埏土作外模，剖破两边形或为两截，以子口串合，翻刻书文于其上。内模缩小分寸，空其中体，精算而就。外模刻文后，以牛油滑之，使他日器无粘连。然后盖上，混合其缝而受铸焉。巨磬、云板，法皆仿此。

釜

凡釜储水受火，日用司命系焉。铸用生铁或废铸铁器为质。大小无定式，常用者径口二尺为率，厚约二分。小者径口半之，厚薄不减。其模内外为两层，先塑其内，俟久日干燥，合釜形分寸于上，

【今译】

人抬起炉子，将溶液倾注在铸模孔中。甲炉浇完，乙炉迅速接着浇注，丙炉又赶快跟上，模内金属自然黏合。如相接迟缓，则先注入的金属快凝结，不易与后注入的金属黏合，结果造成缝隙。

做铸铁钟用的铸模不须耗费太多牛油、黄蜡，先以土黏合做成外模，将其纵向剖开成左右两半，或横向分为上下两截，以子母口使之接合，将文字、图案的反体刻在上面。内模尺寸略小些，经精心计算，使内、外模之间有一定空隙。外模（内壁）上刻好文字图案后，用牛油涂滑，使铸出的钟不与铸模粘连。然后将内外模合起，用泥浆填补好接口的缝隙，便可进行浇铸。做巨磬、云板的方法也与此相仿。

釜

铁锅用作储水、受火，日常生活不可缺少。铸锅时用生铁或废的铸铁器为原料。大小没有固定格式，常用的铁锅口径以二尺为准，厚约二分。小者口径减半，厚薄不变。其铸模分内、外两层，先塑造其内模，放多日干燥后，根据锅形状大小，然后再做置于内模之上的外

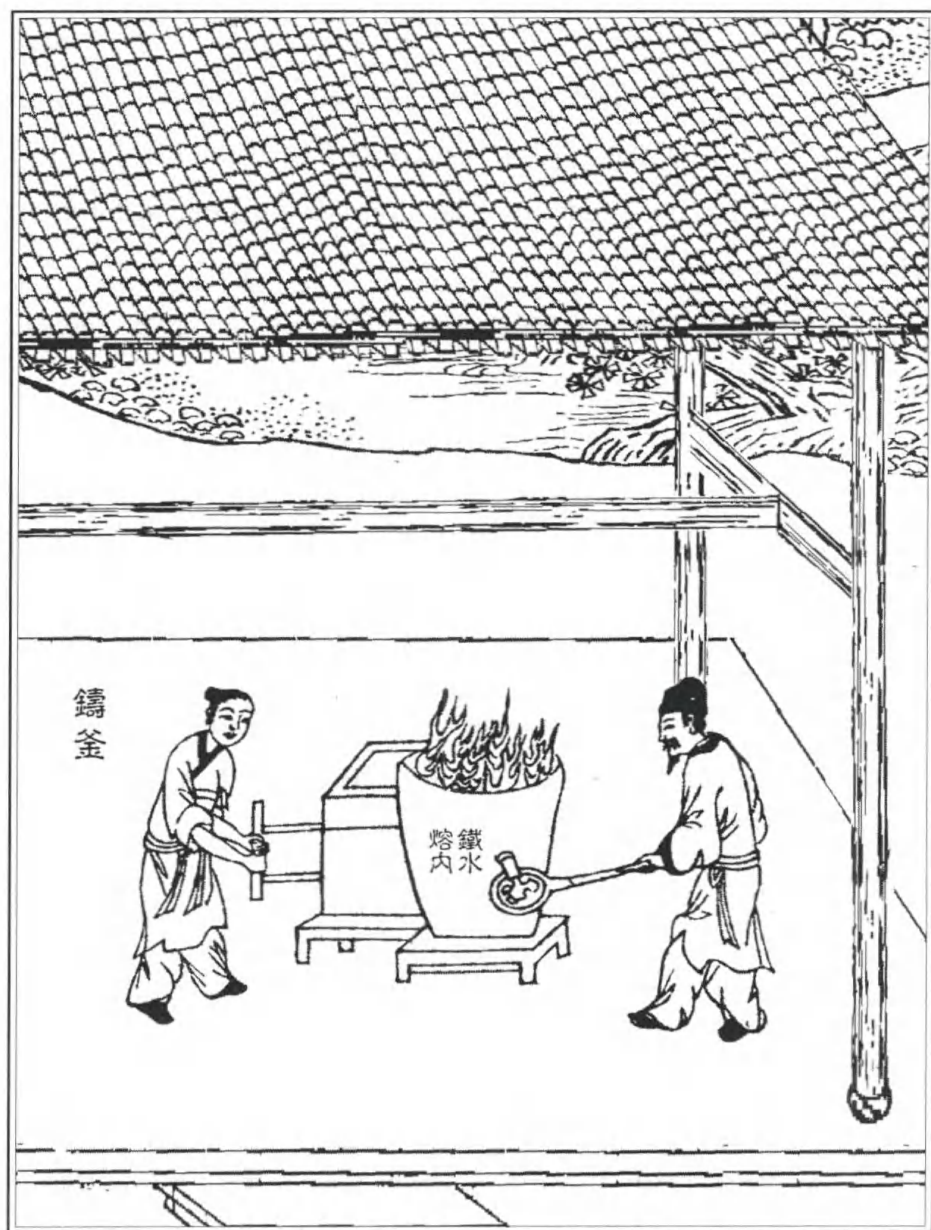


copper is melted, the smelter is lifted by two men, if it is light, or several people, if it is heavy, in order to pour the melted copper into the casting hole. One smelter is followed immediately by another one so that the metals in the mold can join together naturally. If this is not done quickly enough, the copper poured in first will coagulate and it will be difficult for it to combine with the metal poured in later. As a result, slits will form.

Not too much tallow or yellow wax is needed to make molds for casting iron bells. The outer mold is made of clay. Then it is cut lengthwise or widthwise into two parts which are then connected by dowel pins. Characters and patterns are carved onto the inner surface of the outer mold in reverse. The inner mold should be slightly smaller than the outer mold. There is a certain inter-space between the two molds created by careful calculations. The outer mold (inner surface) should be spread with tallow so that the bell won't adhere to the mold. After the two parts of the mold are joined, the cracks should be sealed together with mud before casting. The method of making big chimes and cloud-shaped musical boards is similar to this.

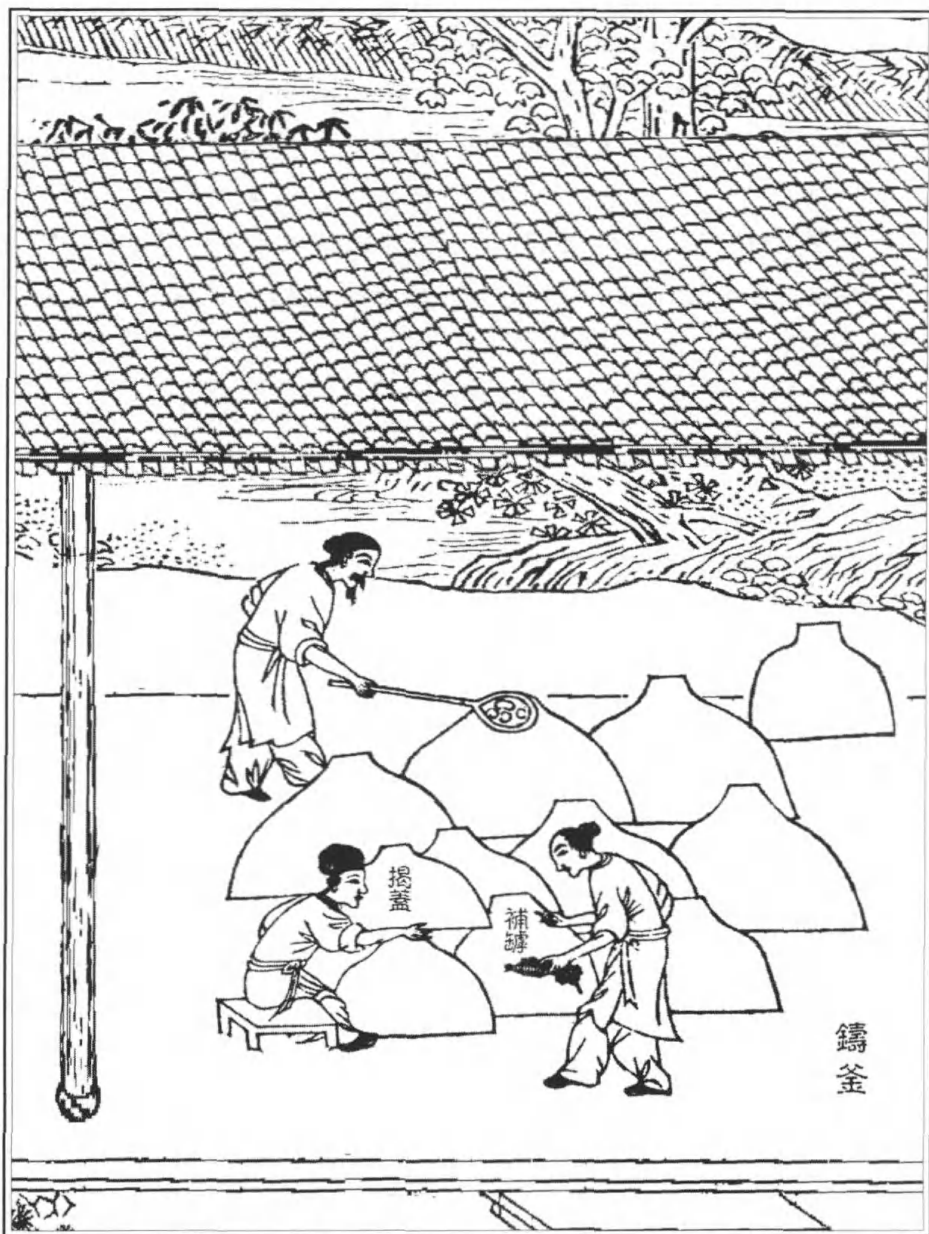
Casting of Cauldrons

Cauldrons are used to store water and heat things, so they are indispensable in daily lives. Pig iron or old and useless iron-casting implements are used as the raw materials for casting cauldrons. There are no fixed sizes for cauldrons. Commonly used cauldrons usually have a diameter of two *chi* and a thickness of around two *fen*. The small ones have half of the diameter of the common ones but the same thickness. A casting mold for a cauldron is made up of inner and outer layers. The inner mold is made first. After it has dried in the sun for several



铸釜

Casting cauldrons



鑄釜

Casting cauldrons



【原文】

然后塑外层盖模。此塑匠最精，差之毫厘则无用。

模既成就干燥，然后泥捏冶炉，其中如釜，受生铁于中。其炉背透管通风，炉面捏嘴出铁。一炉所化约十釜、二十釜之料。铁化如水，以泥固纯铁柄勺从嘴受注。一勺约一釜之料，倾注模底孔内，不俟冷定即揭开盖模，看视罅绽未周之处。此时釜身尚通红未黑，有不到处即浇少许于上补完，打湿草片按平，若无痕迹。

凡生铁初铸釜，补绽者甚多，唯废破釜铁熔铸，则无复隙漏。（朝鲜国俗破釜必弃之山中，不以还炉。）凡釜既成后，试法以轻杖敲之。响声如木者佳，声有差响，则铁质未熟之故，他日易为损坏。海内丛林大处，铸有千僧锅者，煮糜受米二石，此直痴物云。

【今译】

层盖模。做外模的匠人要非常精细地操作，稍差一点，模就没有用了。

模做成并干燥后，再用泥捏成熔炉，其内部像锅，装生铁于其中。炉的背后接管通风，炉的前面留出一口以出铁。一炉熔化的铁水，大约可铸十至二十口锅。铁化成水后，用垫泥的有柄铁勺从炉嘴接铁水。一勺铁水大约浇一口锅，倾注在模底孔中，不待冷定即揭开盖模，看看有无裂缝不周之处。此时锅身尚通红未变黑，有浇不到之处，即浇少许铁水于其上补完，用湿草片压平，不留修补痕迹。

用生铁初次铸锅，要补破绽之处很多，只有用废破铁锅熔铸，才没有隙漏。（朝鲜国俗，破锅必弃之山中，不再回炉。）锅铸成后，试锅方法是用木棍轻敲，响声如敲木头的声音，就是好锅。如有杂音，则说明铁质还不够纯熟。日后使用易于损坏。国内大寺庙里铸有千僧锅，可煮二石米的粥，这简直是笨重之物。



days, an outer layer mold is made to cover the inner one according to the size of the cauldron. The artisans making outer molds should be extremely careful with the operation or the molds will be useless if they have even a tiny defect.

After a mold is finished and dried, a smelter, the inner part of which resembles a cauldron and contains pig iron, should be made out of clay. The backside of the smelter should have tubes installed for ventilation, the front side an opening for the iron to come out. Molten iron produced from one smelter can cast ten to twenty cauldrons. After being melted, the iron is taken from the smelter mouth by an iron ladle padded with earth. A cauldron is molded with about one ladle of molten iron. This is poured into the hole at the bottom of the mold. The mold cover should be removed before the iron cools down to see if there are any cracks or defects. Then the cauldron, glowing red and not yet turned to black, should be mended with a little molten iron where cracks appear. Then smooth it over with wet grass leaves to leave no trace.

In a cauldron made with pig iron, there will be many defects that need to be repaired. Only cauldrons made with molten waste iron have no cracks. (It is a national custom in Korea that waste cauldrons must be discarded in the hill areas and not be put into smelters again). The testing method for a finished cauldron is to knock it with a wooden stick. If the resulting sound is like knocking wood, it can be considered a cauldron of good quality; but an inferior noise is the sign that the iron had not been refined enough and that the cauldron will be easily damaged. In large temples in our country, there are cauldrons for 1,000 monks which can be used to cook porridge with as many as two *dan* of rice. They are simply huge implements.



【原文】

像

凡铸仙佛铜像，塑法与朝钟同。但钟鼎不可接，而像则数接为之，故泻时为力甚易。但接模之法，分寸最精云。

炮

凡铸炮西洋红夷、佛郎机等用熟铜造，信炮、短提铳等用生、熟铜兼半造，襄阳、盏口、大将军、二将军等用铁造。

镜

凡铸镜模用灰沙，铜用锡和（不用倭铅）。《考工记》亦云：“金锡相半，谓之鉴燧之剂。”开面成光，则水银附体而成，非铜有光明如许也。唐开元宫中镜，尽以白银与铜等分铸成，每口值银数两者，以此故。朱砂斑点乃金银精华发现（古炉有入金于内者）。我朝宣炉亦

【今译】

像

铸仙佛铜像，做铸模的方法与朝钟同。但钟鼎不可由几部分接合，而铜像则可由几部分接合铸造，故浇注时省力省事。但接模之法，精确度要求很高。

炮

西洋红夷炮、佛郎机等用熟铜为原料铸造，信炮、短提铳等用生铜、熟铜各半铸造，襄阳炮、盏口炮、大将军、二将军等炮用铁铸造。

镜

铸镜用的模由草木灰及细沙做成，而镜由铜和锡做成（不用铍）。《考工记》亦云：“金（铜）、锡各一半的合金，是制作鉴和燧的材料。”镜面反光，因镜身附有水银，并非铜有这种光泽。唐代开元年间宫中的镜，都以白银与铜各半配合铸成，每面镜价值达数两银子，就因为这个缘故。镜面上有像朱砂色的斑点，是其中所含金银成分的表现（古代铸香炉，加金于其中）。本朝的宣德炉，也因当时某库偶然发



Casting of Figures of Buddha

The casting method of molds for the figures of Buddha is the same as that for the Audience Bells. While the bells and tripods are cast in one piece, the statues, however, can be cast in sections; therefore, the engraving of designs is much easier. The piecing together of the mold, on the other hand, must be executed with the greatest skill.

Casting of Cannon

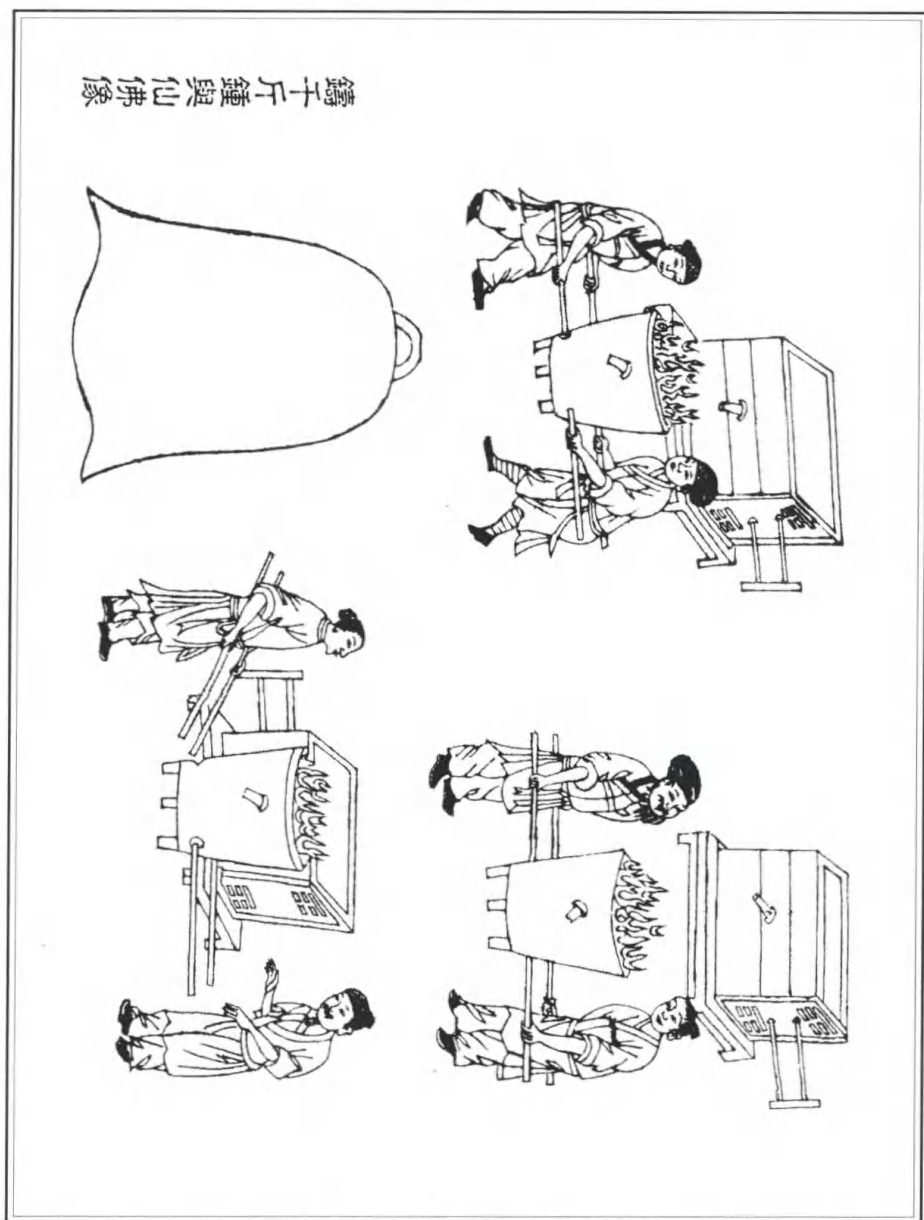
Refined copper is used in the casting of Western cannon, Dutch cannon and Portuguese cannon. Equal amounts of refined and raw copper are used in making such arms as signal guns and muskets. For making guns like Xiangyang, Zhankou, Great General and Deputy General, iron is used.

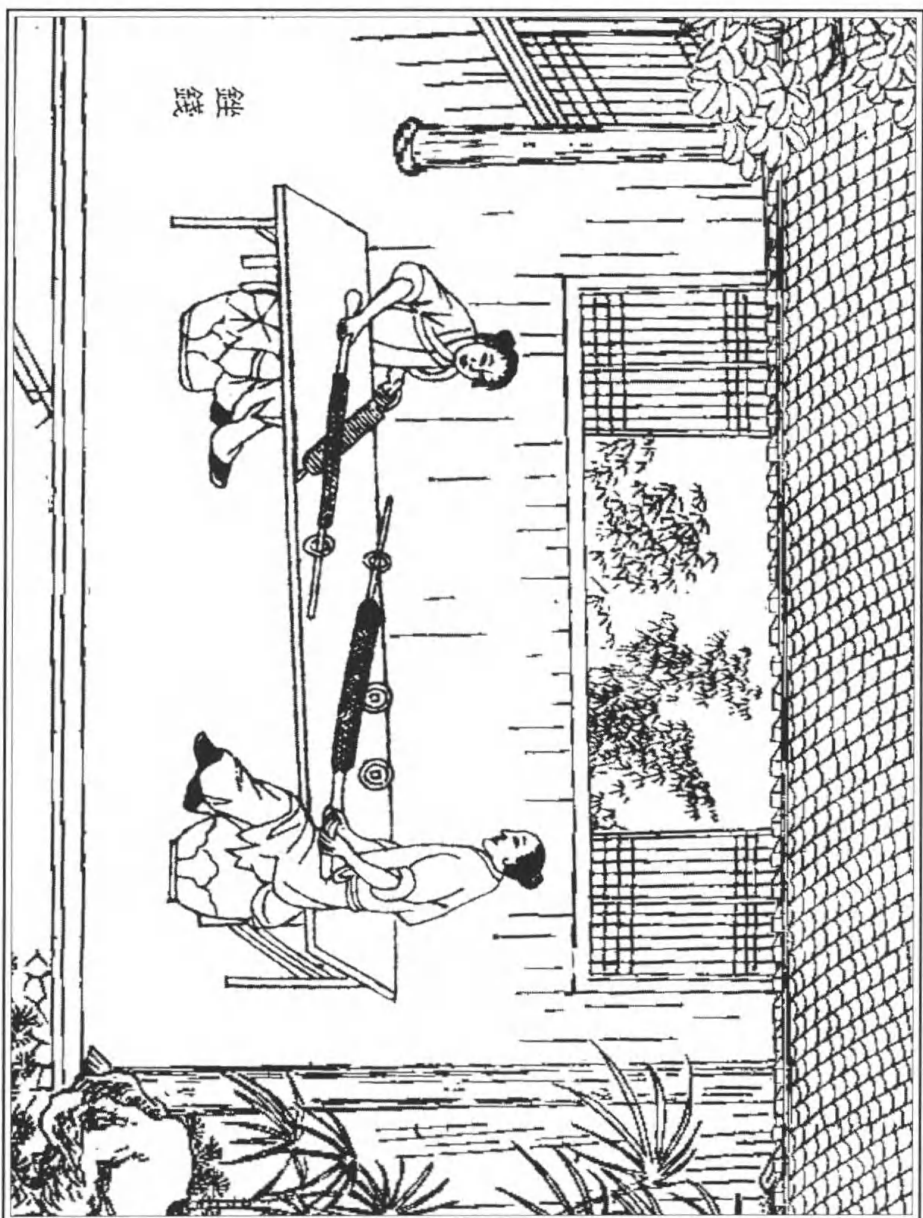
Casting of Copper Mirrors

The molds for casting mirrors are made from plant ashes and fine sand, and the mirrors are made from copper and tin (zinc is not used). According to *Artificers' Record* "alloy of half gold (copper) and half tin is the material for casting dressing mirrors and collecting mirrors". The reason why a mirror surface can reflect light is that there is a mercury covering. Copper does not have the sheen. During the Kaiyuan period of the Tang Dynasty, mirrors in the palaces were all cast with half silver and half copper. That's why every mirror is worth several *liang* of silver. The vermilion-like spots on the mirrors show that the materials contain gold or silver. (Gold was added to cast censers in ancient times.) The Xuande censer of the present dynasty was cast when an accidental fire in a storeroom melted gold, silver, copper and tin into a



铸千斤钟与仙佛像
Casting a one-thousand-jin bell and a statue of Buddha





銚錢

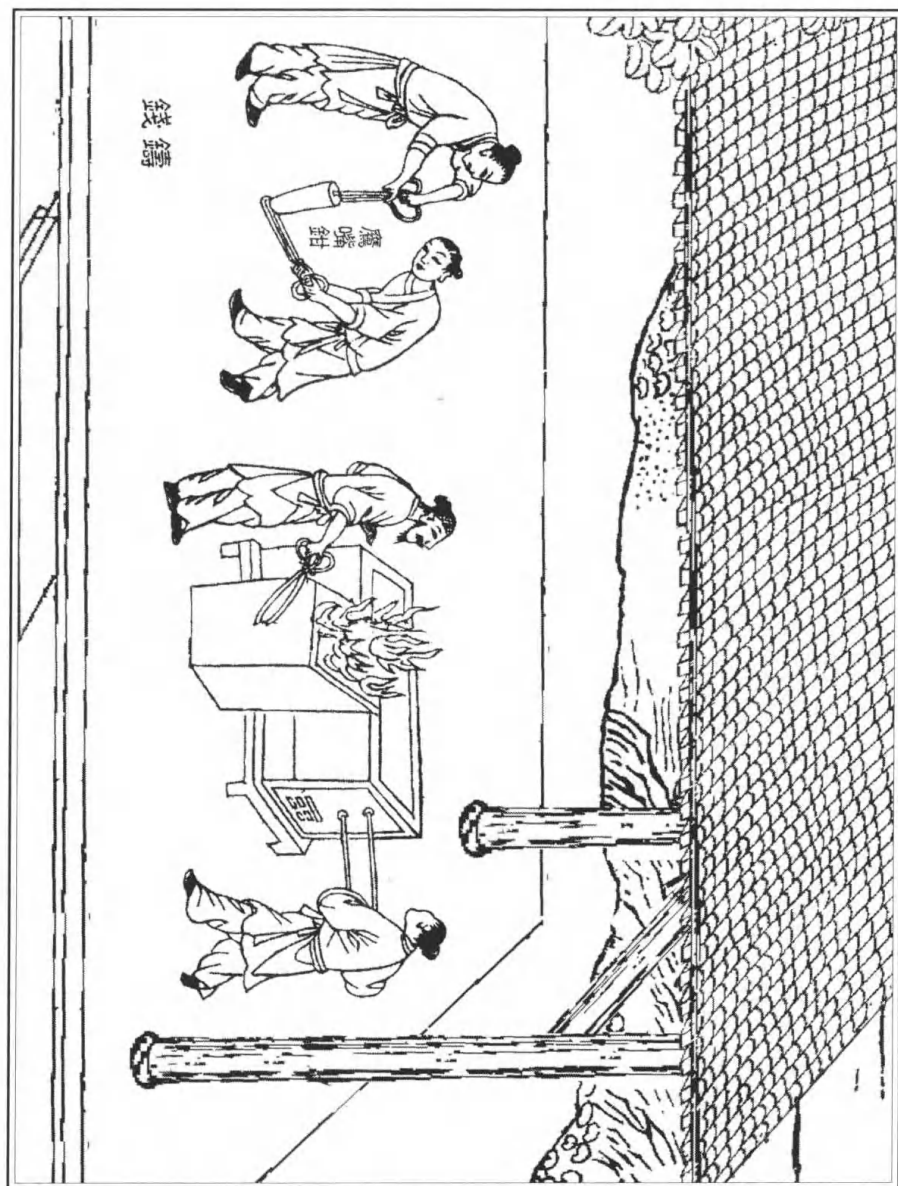
銚錢

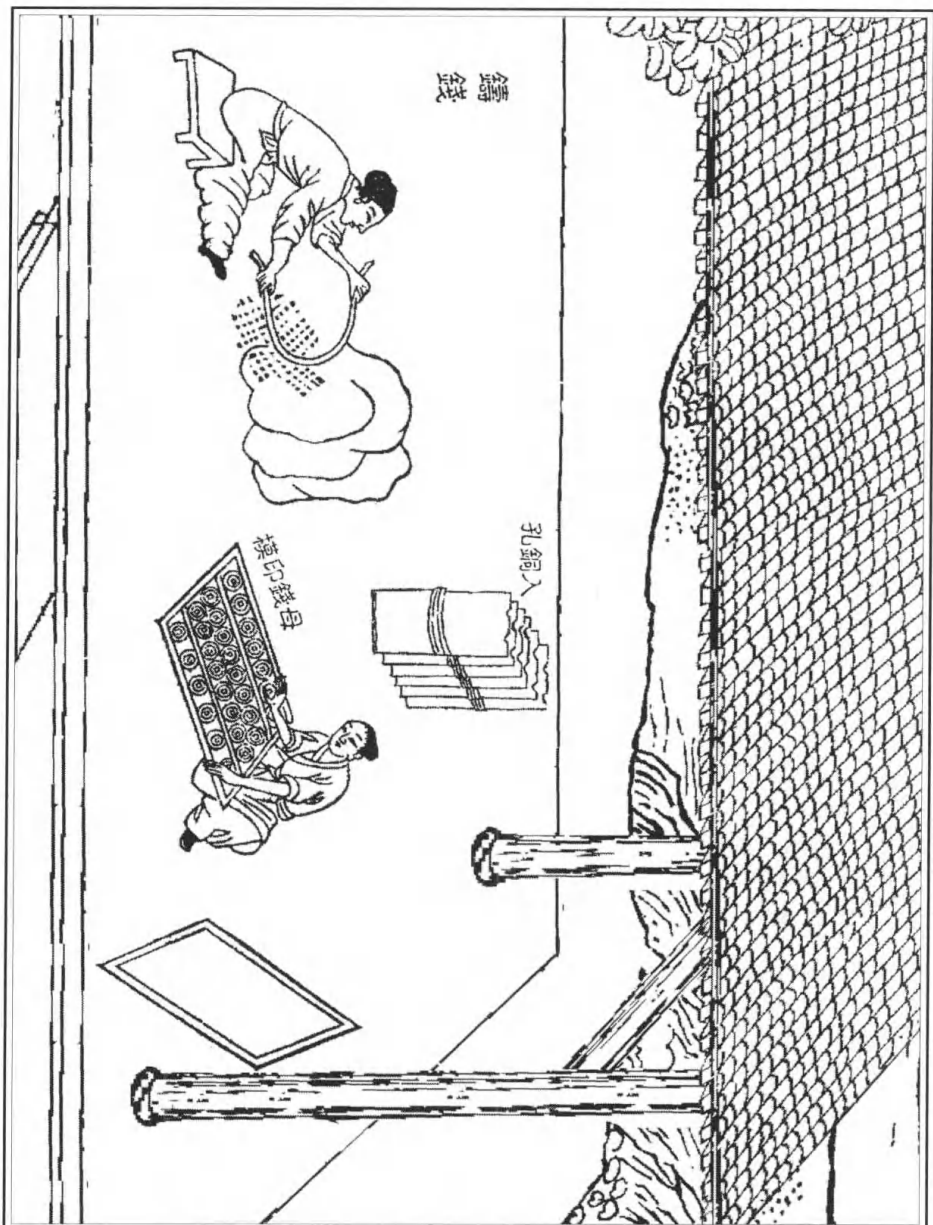
Filing coins



铸钱

Casting coins





鑄錢

Casting coins



【原文】

缘某库偶灾，金银杂铜锡化作一团，命以铸炉（真者错现金色）。唐镜、宣炉皆朝廷盛世物也。

钱

凡铸铜为钱，以利民用。一面刊国号通宝四字，工部分司主之。凡钱通利者，以十文抵银一分值。其大钱当五、当十，其弊便于私铸，反以害民，故中外行而辄不行也。凡铸钱每十斤，红铜居六七，倭铅（京中名水锡）居四三，此等分大略。倭铅每见烈火必耗四分之一。我朝行用钱高色者，唯北京宝源局黄钱与广东高州炉青钱（高州钱行盛漳、泉路），其价一文敌南直、江浙等二文。黄钱又分二等，四火铜所铸曰金背钱，二火铜所铸曰火漆钱。

凡铸钱熔铜之罐，以绝细土末（打碎干土砖妙）和炭末为之。（京炉用牛蹄甲，未详何作用。）罐料十两，土居七而炭居三，以炭灰性暖，

【今译】

生火灾，其中金银与铜锡掺杂熔化在一起，下令用以铸宣德炉（真品上闪现金色）。唐镜和宣炉都是朝廷盛世之物。

钱

将铜铸成钱，是为便于民用。钱的一面铸有年号“某某通宝”四字，工部有专门机构掌管此事。通行的铜钱十文等于一分银的价值。相当五分、十分银的大钱，缺点是便于伪铸，反而害民，故中央和地方发行后又不通行。每铸十斤铜钱，用红铜六或七斤，锌（京中叫水锡）四或三斤，这是大致的比例。锌每遇高温，必损耗四分之一。本朝通用钱成色高的，只有北京宝源局的黄钱和广东高州府的青钱（高州钱通行于福建漳州、泉州地区），其面值一文等于南直隶、浙江的二文。黄钱又分二等，用四火铜所铸的叫金背钱，二火铜所铸的叫火漆钱。

铸钱熔铜的坩埚，是用绝细土面（打碎的干土砖最好）和木炭粉做成的。（北京炉用牛蹄甲，不知道有何作用。）每十两坩埚原材料中，土面占七两，木炭粉占三两，因为炭粉能保温，与土面配合使铜易于熔



mixture which was then ordered to be made into a censer. (The genuine Xuande censer glitters golden colour.) The Tang mirror and the Xuande censer represent the prosperity of the ruling courts.

Casting of Copper Coin

Copper coins are cast for civil use. One side of the coin is cast with four characters “xx *tongbao*” to indicate the currency of a particular dynasty. There were special bureaus within the Ministry of Works in charge of this. Ten current copper coins equal one *fen* of silver. The disadvantage of big coins which equal five *fen* or ten *fen* is that they are easily counterfeited, so they are harmful to civilians. That’s the reason why in all parts of the empire the circulation of coins is frequently stopped. Every ten *jin* of copper coins needs an approximate proportion of six or seven *jin* of red copper and three or four *jin* of zinc (called “water tin” in the capital city of Beijing). At a high temperature, zinc will lose a quarter of it. The current highly pure coins used in this dynasty are only the yellow coins produced in the Baoyuan Bureau in Beijing. The black coins are made by the Gaozhou Prefectural Government in Guangdong Province (The Gaozhou coins are used in Zhangzhou and Quanzhou in Fujian Province.) and one *wen* of it is worth two *wen* in the directly-governed area in the south and Zhejiang Province. The yellow coins are divided into two grades: those cast with four-time purified copper are called golden-surface coins; and those with twice-purified copper, sealing wax coins.

The cauldrons for smelting copper in coin casting are produced from extremely fine earth (smashed dry adobes are the best) and charcoal powder. (It is unknown why cattle hoofs and horns are used to make cauldrons in Beijing.) Every ten *liang* of materials for casting a cauldron include 7



【原文】

佐土易化物也。罐长八寸，口径二寸五分。一罐约载铜、铅十斤，铜先入化，然后投铅，洪炉扇合，倾入模内。

凡铸钱模以木四条为空框（木长一尺二寸，阔一寸二分）。土炭末筛令极细，填实框中。微洒杉木炭灰或柳木炭灰于其面上，或熏模则用松香与清油。然后以母钱百文（用锡雕成），或字或背布置其上。又用一框如前法填实合盖之。既合之后，已成面、背两框，随手覆转，则母钱尽落后框之上。又用一框填实，合上后框，如是转覆，只合十余框，然后以绳捆定。其木框上弦原留入铜眼孔，铸工用鹰嘴钳，洪炉提出熔罐。一人以别钳扶抬罐底相助，逐一倾入孔中。冷定解绳开框，则磊落百文如花果附枝。模中原印空梗，走铜如树枝样，夹出逐一摘断，以待磨锉成钱。凡钱先锉边沿，以竹木条直贯数百文受锉，后锉平面则逐一为之。

【今译】

化。坩埚长八寸，口径二寸五分。一坩约装铜、铅十斤。先将铜装入熔化，然后投入铅。熔炉鼓风，倾注熔液于铸钱模内。

铸钱的模，用四根木条做成空框木条（长一尺二寸，宽一寸二分）。用筛选极细的土面、木炭粉填实于框中，上面微撒些杉木炭粉或柳木炭粉，或用松香与菜子油的烟熏模。然后把一百个母钱（钱模）（用锡刻成），按有字的正面或无字的背面铺排在框面上。再用一个木框按前法填实土面、炭粉，对准盖在此木框之上。盖合之后，便构成钱的面、背两个框模，随手翻转过去，则钱模尽落于后框之上。再用另一木框填实，合盖在后框上，照样翻转。这样反复做成十多个框模，然后将其以绳捆定。木框上边缘留有注入铜的眼孔，铸工用鹰嘴钳把熔铜坩埚从炉中取出，一人用另一铁钳扶托坩埚底，逐一将溶液注入模的孔中。冷却后解绳打开框，则一百个铜钱像树枝上的花果一样呈现出来。模中原刻出流铜液的空沟，铜流动冷却后成树枝形状，夹出逐一摘断，以待磨锉成钱。钱要先锉边沿，方法是用竹、木条将数百个铜钱直串起来一起磨锉。接下逐个锉平钱表面不规则的地方。



liang of earth and 3 *liang* of charcoal powder. Charcoal powder preserves heat and the mixture of earth and charcoal powder makes it easier for melting copper. The height of a cauldron is 8 *cun* and the diameter is 2.5 *cun*. It contains ten *jin* of copper or zinc. Copper is first melted in the cauldrons and then zinc is added. The smelted material is then poured into the coin-casting molds.

A coin mold is a frame made from four pieces of wood (whose length is 1.2 *chi* and whose width is 1.2 *cun*). Extremely fine screened earth and charcoal powder are put on the screen and pressed through the frame. This resulting powder is sprayed on top of a little charcoal powder made from fir or willow. Or the mold can be fumed with smoke of colophony or colza oil. Then 100 head or tail of mother coins molds made of tin are spread upon its surface. In the former way, press the earth and powder with a wooden frame onto the original frame so that the head and tail molds are formed on the back frame. Then press, using another frame, the back frame again and turn it in the same way. After several repetitions, ten frame molds or so will be produced. Later they should be tied up with ropes. There should be holes on the edges of the frames so that liquid copper can be poured through them. Then a founder gets the copper-melting cauldron out from the smelter with an eagle-beak clamp. Another clamp is then used to hold the bottom of the cauldron while the melt is poured into the holes. After the cooling, unbind the frames so that one hundred coins appear like fruits on branches. The branches are formed because there are holes for the melt to flow out into the molds. After cooling, the melt which forms the branches will be broken by clamps and rasped away. The coins should be filed along their edges. Hundreds of coins are bunched with bamboo or wooden bars so they can be rasped together. Next, the uneven part



【原文】

凡钱高低以〔倭〕铅多寡分，其厚重与薄削则昭然易见。铅贱铜贵，私铸者至对半为之。以之掷阶石上，声如木石者，此低钱也。若高钱铜九铅一，则掷地作金声矣。凡将成器废铜铸钱者，每火十耗其一。盖铅质先走，其铜色渐高，胜于新铜初化者。若琉球诸国银钱，其模即凿楔铁钳头上。银化之时入锅夹取，淬于冷水之中，即落一钱其内。

附：铁钱

铁质贱甚，从古无铸钱。起于唐藩镇魏博诸地。铜货不通，始冶为之，盖斯须之计也。皇家盛时，则冶银为豆，杂伯衰时，则铸铁为钱。并志博物者感慨。

【今译】

钱的成色高低，以含锌多少来区分。其厚重与轻薄，是显而易见的。由于锌贱而铜贵，私铸者甚至将二者对半配合铸钱，将钱扔到石阶上，声音像木石的是成色低的钱。如含铜十分之九、含锌十分之一的成色高的钱，则掷落在地上有金属声。用废铜器铸钱，每熔化一次要损耗其十分之一。因锌先行跑掉，剩下的铜成色逐渐提高，胜于用新铜初次熔化的钱。至于琉球诸国铸的银币，其钱模就刻在铁钳头上。银熔化时，用钳头从坩埚里夹取银液，在冷水中淬火，则一块银币便落水中。

附：铁钱

铁这种原料很贱，自古以来不用以铸钱。铁钱起于唐代藩镇的魏博等地，因买不到铜，遂开始冶铁铸钱，这不过是权宜之计。王朝盛时则冶银为银豆作娱乐，藩镇各霸衰落时，则铸铁为钱，就记此以表博物者之感慨。



of every coin is rasped individually.

The purity of a coin depends on the amount of zinc in a coin. It is easy to discover the differences between thicknesses and weights. This is because zinc is worth less than copper. Illegal minters make coins by casting them using half zinc and half copper. Tossed onto the stone steps, coins with low purity sound like wood or stone while highly pure coins, containing nine-tenth copper and one-tenth zinc, sound like metal. Wasted copper utensils will lose one-tenth of their weight every time they are melted and cast into coins. If old brass articles are re-melted for minting, there will be a ten percent loss in the smelting process, because part of the zinc will be lost, and the resultant product will contain a higher percentage of copper; therefore it is better than coins struck with new copper. As for the silver coins cast by a good many countries in Ryukyu (Islands), the molds of them are carved on the head of clamps. After the silver is melted, it is scooped out of a cauldron using the clamp and quenched in cold water, and a silver coin will be left in the water.

Supplement: Iron Coins

Iron is so cheap that it has rarely been used to cast coins. The casting of iron coins dated back to the Tang Dynasty in seigniorial towns like Weibo only because copper was unavailable. This was just makeshift. In prosperous dynasties, silver is used to make silver beans for entertainment, while in poor dynasties iron was used to cast coins. I write this down for the melancholic pondering of the naturalist.



锤 锻 第 十

【原文】

宋子曰，金木受攻而物象曲成。世无利器，即般、倕安所施其巧哉？五兵之内、六乐之中，微钳锤之奏功也，生杀之机泯然矣。同出洪炉烈火，大小殊形。重千钧者系巨舰于狂渊；轻一羽者透绣纹于章服。使冶钟铸鼎之巧，束手而让神功焉。莫邪、干将，双龙飞跃，毋其说亦有徵焉者乎？

治 铁

凡治铁成器，取已炒熟铁为之。先铸铁成砧，以为受锤之地。谚云：“万器以钳为祖”，非无稽之说也。凡出炉熟铁名曰毛铁。受锻之时，十耗其三为铁华、铁落。若已成废器未锈烂者，名曰劳铁。

【今译】

宋子说，金属、木材经加工处理，造成各种器物。世上如果没有得力的工具，即使鲁班、倕那样的巧匠，也怎能施展其技巧呢？在制造各种兵器和金属乐器的过程中，如果不用钳和锤加工，便无法做成。各种工具和器物都经过熔炉烈火的作用锻造而成，但形状、大小有所不同。重达千钧的铁锚将大船系于狂渊之中，轻如羽毛的铁针在官服上绣出花纹。铸造钟鼎的技巧与这种神奇的锻造工艺相比，也相形见绌。古时锻造的名剑莫邪、干将挥舞起来如双龙飞跃，这种传说大概是有根据的吧？

锻 铁

锻造铁器，是用炒过的熟铁为原料。先用铸铁做成砧，作为承受锤打的底座。有句俗话说“万器以钳为祖”，并非无稽之谈。刚出炉的熟铁，叫“毛铁”，锻打时损耗十分之三，变成铁花、铁滓。用过的废品还未锈烂的，叫“劳铁”，可用以改制成别的器物或原来的



Chapter 10

Forging

Songzi says that metals and timber are made into various appliances through machining. Without right-handed tools, artisans even like Luban and Chui, in ancient China, could not demonstrate their wonderful skills. Without clamps or hammers, the processes of producing various weapons and metallic musical instruments could not be finished. All tools and appliances are forged by blazes in smelters, but the tools and appliances vary in shapes and sizes. Anchors as heavy as three thousand *jin* anchor in raging waves; needles as light as a feather make floral patterns on a ceremonial robe. These wonderful arts and crafts outshine those of casting bells and tripods. Yet if we assign all the credit of superb smelting and casting to supernatural forces, it seems that proof of this can be found in the story of Moye and Ganjiang swords, and in the rise heavenward of the two famous swords which seemed to turn into two dragons after being wielded. This story may be well-founded.

Making Iron Articles

Iron forging uses wrought iron. First, cast iron is made into an anvil as the pedestal to sustain the hammering. It is truly said that "all things stem from a pair of forceps". The wrought iron that has just emerged from the forge is called "unfashioned iron", which will lose thirty percent of its volume in the form of sparks and droppings after being forged. Iron that is already used and not rusted yet is called



【原文】

改造他器与本器，再经锤锻，十只耗去其一也。凡炉中炽铁用炭，煤炭居十七，木炭居十三。凡山林无煤之处，锻工先择坚硬条木烧成火墨（俗名火矢，扬烧不闭穴火），其炎更烈于煤。即用煤炭，也别有铁炭一种，取其火性内攻，焰不虚腾者，与炊炭同形而分类也。

凡铁性逐节黏合，涂上黄泥于接口之上，入火挥槌，泥淬成枵而去，取其神气为媒合。胶结之后非灼红斧斩，永不可断也。凡熟铁、钢铁已经炉锤，水火未济，其质未坚。乘其出火之时入清水淬之，名曰健钢、健铁。言乎未健之时为钢为铁，弱性犹存也。凡焊铁之法，西洋诸国别有奇药。中华小焊用白铜末，大焊则竭力挥锤而强合之。历岁之久，终不可坚。故大炮西番有锻成者，中国则唯事冶铸也。

【今译】

器物，再经锻造时只损失十分之一。炼铁炉中的燃料，煤炭占十分之七，木炭占十分之三。在山林无煤之地，锻工选择坚硬木条烧成火墨（俗名叫“火矢”，燃烧时不会变为碎末堵塞通风口），其火焰比煤更猛。即使用煤炭，也另有一种铁炭，取其燃烧时火势向内、火焰不虚散的优点，与烧饭用的煤形状相同而种类不同。

把要锻造的铁逐节黏合起来，在接口处涂上黄泥，再放在火中烧红后捶打，将泥滓打去，只将黄泥作为接合的媒介。铁器锤合之后，除非烧红再用斧砍，否则是永不会断的。熟铁、钢铁经烧红、锻打后，水火作用尚未调合，其质地不坚。乘出炉时将物料放入清水中淬火，名为健钢、健铁。这是说未“健”之前，作为钢和铁还存有软弱的性质。焊接铁的方法，西洋各国另有奇药。中国小焊用白铜粉作焊药，大件的锻接则竭力挥锤而强行接合。但经年累月之后，接口终究不牢。因此大炮虽在西洋有锻成的，而中国还只靠铸造而成。



“used iron” which can be changed to other implements or the original ones and will only lose ten percent when forged. Coal accounts for seventy percent, and charcoal thirty percent of the fuel used for heating the iron in the forge. In places where no coal is produced, ironsmiths burn hard wooden sticks into hardwood charcoal. (It is called “fine arrows” and can easily be burned in a furnace without blocking its vent.) The resulting fire is much stronger than that made from coal. Even though coal is used, another kind of coal called iron coal should be used. It contains intense internal heat but does not waste it in high flames. It has a shape as coal used for cooking, but they are different.

Before being burned red in fire and then being hammered, pieces of wrought iron should be joined together using yellow mud. Then the mud which is only a linking agent should be washed off. After being hammered, those iron implements can’t be broken unless melted in fire again and cut with axes. The hammer-forged articles of wrought iron and steel are not very hard before the correct balance of water and fire has been achieved, and therefore should be quenched in clear water immediately after being taken from the forge, which is called the quench hardening of steel and iron, meaning that before these soft properties of iron and steel were not yet entirely removed. This means that before “being put into clear water”, steel and iron still have the quality of mildness. In Western countries, there are other wonderful materials to join the iron. In China, soldering paste for small items is cupronickel powder while for big items the joining can only be achieved by forceful hammerings. Years later, however, the joints will not remain firm. As a result, though there are forged cannons in Western countries, in China cannons are made only by casting.



【原文】

斤、斧

凡铁兵薄者为刀剑，背厚而面薄者为斧斤。刀剑绝美者以百炼钢包裹其外，其中仍用无钢铁为骨。若非钢表铁里，则劲力所施，即成折断。其次寻常刀斧，只嵌钢于其面。即重价宝刀，可斩钉截铁者，终数千遭磨砺，则钢尽而铁现也。倭国刀背阔不及二分许，架于手指之上，不复欹倒，不知用何锤法，中国未得其传。

凡健刀斧皆嵌钢、包钢，整齐而后入水淬之，其快利则又在砺石成功也。凡匠斧与椎，其中空管受柄处，皆先打冷铁为骨，名曰羊头。然后热铁包裹，冷者不沾，自成空隙。凡攻石椎，日久四面皆空，熔铁补满平填，再用无弊。

锄、钁

治地生物用锄、钁之属，熟铁锻成，熔化生铁淋口，入水淬健，

【今译】

斤、斧

铁制兵器，薄者为刀、剑，背厚而刃薄者为斧、砍刀。绝美的刀剑用百炼钢包在其表面，里面仍用熟铁为骨架。如果不是钢表铁里，则用力过猛便要折断。其次，通常用的刀斧，只嵌钢在其刃面。即使是可以斩钉截铁的贵重宝刀，经几千次磨过后也会将钢磨尽而露出铁的。日本刀的刀背不到二分宽，但架在手指之上并不倾倒，不知是用什么方法锻造出来的，这种技术还没有传到中国。

热处理过的刀斧，都要嵌钢、包钢，修整以后放入水中淬火，其锋利与否全在磨石上下工夫。锻工所用的斧和锤，其装木柄的空腔都要先打冷铁为骨，名曰羊头，再用烧红的铁将其包住。冷铁不粘连热铁，取出后自成空隙。打石用的锤，用久了四面都会损耗而凹陷下去，用熔化的铁补满填平，便可继续使用。

锄、钁

整治土地、种植庄稼用的锄头和阔口锄之类，以熟铁锻成，再将熔化的生铁淋在锄口，入水中淬火后，即变得硬而坚韧。重一斤



Broadswords and Axes

Among iron weapons, thin ones are broadswords and swords while the ones with thick backs and thin blades are axes and choppers. Those admirable broadswords and swords are covered with steel tempered many times while the frameworks are made of wrought iron. Otherwise the sword will break off when it is used with vigor. The ordinary broadswords and axes are inlaid with steel on the cutting edge only. But the steel coating on even the costliest broadswords, which can chop nails and cut through ordinary iron, will disappear and the iron core will show up after the blade has been ground and sharpened a few thousand times. In Japan, the back of the broadswords blade is less than 0.2 *chi* wide, yet will stand on one's finger without toppling. The process for forging this kind of broadsword is not known in China.

All broadswords and axes processed using heat treatment should be coated or inlaid with steel and should be put into water to be quenched after finishing. The sharpness of the blades depends on the work spent on the whetstones. The cavities for wooden handles of axes and hammers used by ironsmiths should all have cold iron as frameworks called "ram's head" and then be wrapped with hot iron. The cavities are formed because cold iron does not adhere to hot iron. There will be hollow space in axes and mallets after they are outworn. They can be used again after being filled with melt iron.

Hoes

Hoes for ploughing fields and planting and hoes with broad mouths are forged from wrought iron. Then sprinkle melted pig iron onto the hoe mouths so that the hoes will become hard and tough after



【原文】

即成刚劲。每锹、锄重一斤者，淋生铁三钱为率。少则不坚，多则过刚而折。

锉

凡铁锉纯钢为之，未健之时钢性亦软。以已健钢鏊划成纵斜纹理，划时斜向入，则纹方成焰。划后烧红，退微冷，入水健。久用乖平，入火退去健性，再用鏊划。凡锉开锯齿用茅叶锉，后用快弦锉。治铜钱用方长牵锉。锁钥之类用方条锉。治骨角用剑面锉。治木末用锥成圆眼，不用纵斜文者，名曰香锉（划锉纹时，用羊角末和盐、醋先涂）。

锥

凡锥熟铁锤成，不入钢和。治书篇之类用圆钻，攻皮革用扁钻。梓入转索通眼、引钉合木者用蛇头钻。其制颖上二分许，一面圆，

【今译】

的锹、锄，淋上生铁三钱为最好。淋少则不坚硬，淋多又太硬又容易折断。

锉

锉用纯钢做成。未淬火时，钢性较软。用已淬火的钢用平口凿在锉坯表面上开出纵、斜的纹理，划纹理时斜向进凿，纹理锋芒才能像火焰状那样。凿纹后入火烧红，取出稍冷一下，再入水中淬火。锉刀用久后便磨平，这时要退火使钢性变软，再用平口凿重新划出纹理。各种锉当中，开锯齿用茅叶锉（三角锉），再用快弦锉（半圆锉）。加工铜钱用方长牵锉。加工锁头和钥匙用方条锉。加工骨角用剑面锉。加工木料则用香锉，锉面没有纵纹、斜纹，而是锥成一些圆眼（开锉纹时，先将羊角粉、盐与醋拌和，涂上后再开凿）。

锥

锥钻用熟铁锤成，不必加钢。修整书籍之类用圆锥，缝皮革用扁锥。木工转绳穿孔以打钉拼合木件的，用蛇头钻。其形制是钻尖长二



being quenched in water. The best way is that every one *jin* of shovel or hoe should be sprinkled with three *qian* of pig iron, less than which the product will not be hard enough and more than which the tools will be so hard that they will be easily broken.

Files

Files are made with pure steel. Before being quenched, the steel is soft. Then longitudinal and diagonal lines are curved by flat mouth chisels of quenched steel on file flans. Only if the chisels advance diagonally when curving the lines could the edges take the shapes of flame. Files will have rubdowns after being used for a long time. In this situation, they should be annealed to make the steel softer and then be curved with new lines by flat mouth chisels. To make saw-teeth, the “straw-leaf” file should be used first, followed by the “arc-sharpening” file; to polish copper coins, the “square-long-pull”; to polish locks, keys, and the like, the “square strip”; to cut and fashion ivory and horns, the “sword-face”; and to work on wood the file is marked with round holes instead of criss-crossed lines and is called “incense” file. (The powder of ram’s horn, mixed with salt and vinegar, is applied to the file before the lines are marked on it.)

Awls

Awls are hammered out of wrought iron without any steel. “Round” awls are used to bind books while “flat” awls are required to sew leather. Snake-head awls are used to make perforations into wooden pieces by woodworkers. The needles of snake-head awls are as long as two *fen*, with one side being like an arc and the other being concave. On both sides, there are two ridges used to draw ropes. Drilling



【原文】

二面剃入，旁起两棱，以便转索。治铜叶用鸡心钻。其通身三棱者名旋钻，通身四棱而末锐者名打钻。

锯

凡锯熟铁锻成薄条，不钢，亦不淬健。出火退烧后，频加冷锤坚性，用锉开齿。两头衔木为梁，纠篾张开，促紧使直。长者剖木，短者截木，齿最细者截竹。齿钝之时频加锉锐而后使之。

刨

凡刨磨砺嵌钢寸铁，露刃秒忽，斜出木口之面，所以平木，古名曰“准”。巨者卧准露刃，持木抽削，名曰推刨，圆桶家使之。寻常用者横木为两翅，手执前推。梓人为细功者，有起线刨，刃阔二分许。又刮木使极光者名蜈蚣刨，一木之上衔十余小刀，如蜈蚣之足。

【今译】

分左右，一面是圆弧形，另一面挖入，旁边有两个棱，以便转动绳索。钻铜片用鸡心钻，钻身有三棱的叫旋钻，带四棱而末端尖锐的叫打钻。

锯

做锯片时，用熟铁锻打成薄条，既不加钢，也不淬火。将薄铁条烧红并冷却后，不断捶打以增加其坚韧性，再用锉刀开齿。使用时，锯条两端的木柄作为锯把，中间再接以横木为梁，然后纠绞竹篾使之张开，再绞紧使锯条伸直。长锯用以剖木，短锯用以截木，锯齿最细的用以截断竹子。锯齿钝时，不断用锉锉锐锯齿，就可以使用了。

刨

做刨时，将包有钢的一寸宽的铁片磨得锋利，斜向装入木制刨口，微微露出刃口，用以刨平木料，古时称作“准”。大的刨则反卧露出刃口，手持木料在上面推拉，名曰推刨，作圆桶的木工使用这种刨。通常用的刨，则在刨身安一横木作为两翼，手持横木两端向前推刨。细木工有起线刨，其刃阔二分。更有将木面刮得极光滑的，名曰蜈蚣刨。在刨壳上装十多个小刨刀，像蜈蚣足一样。



copper sheet requires chicken-heart awls. Those with three ridges are spiral awls while with four ridges and pointed ends are called “boring” awls (drills).

Saws

Saws are made of wrought iron which is forged and hammered into slices without any steel or quenching processes. After being burned hot and cooled down, the slices should be hammered repeatedly to enhance their toughness. Then make saw-teeth using files. When used, the two wooden handles at the two ends of the saw serve as the gripes. A cross-bar in the middle serves as a girder. Then wring a thin bamboo strip to straighten the saw. Long saws are used to cut wood open while short ones can cut wood. Those with thinnest saw-teeth can be used to cut bamboo. When the teeth become blunt, they should be filed sharp for future use.

Planes

Put a one-*cun*-wide sharp iron slice covered with steel into the slot of the plane diagonally. The blade should be exposed slightly to make the timber smooth. It was called “*zhun*” in ancient times. Big planes face reversely and show the blades upwards for timber to be pulled on top of them. They are called “push-planes” and are used by woodworkers to make barrels. Common planes are installed with a bar for wings by which workers push planes forward. Cabinet workers use “pick thread planes” with blades as wide as two *fen*. There are centipede planes which can scrape surfaces really smooth and slick. On the wooden body of the plane are laid about a dozen small blades which resemble the centipede’s feet.



【原文】

凿

凡凿熟铁锻成，嵌钢于口，其本空圆以受木柄。（先打铁骨为模，名曰羊头，勺柄同用。）斧从柄催，入木透眼。其末粗者阔寸许，细者三分而止。需圆眼者则制成剜凿为之。

锚

凡舟行遇风难泊，则全身系命于锚。战船、海船有重千钧者。锤法先成四爪，依次逐节接身。其三百斤以内者，用径尺阔砧安顿炉旁，当其两端皆红，掀去炉炭，铁包木棍夹持上砧。若千斤内外者，则架木为棚，多人立其上共持铁链，两接锚身，其末皆带巨铁圈链套，提起旋转，咸力锤合。合药不用黄泥，先取陈久壁土筛细，一人频撒接口之中，浑合方无微罅。盖炉锤之中，此物最巨者。

【今译】

凿

凿用熟铁锻成，刃口嵌钢，凿身是圆形中空，以便装木柄。（做凿时先锻打一圆管形铁骨为模，叫羊头。做铁勺柄也与此相同。）用斧击凿柄，凿刀入木而凿成孔。凿头刃部粗的宽一寸，细的只宽三分。需凿圆孔的，则制成圆筒形刃口的剜凿。

锚

当船舶航行遇风难以靠岸停泊时，则船体命运皆系于锚。战船、海船所用的锚，有重达千斤的。其锻造方法是先锤成四个锚爪，再逐个接在锚身上。三百斤以内的锚，用直径一尺宽的砧座，安置在炉旁。当工件两端都烧红时，掀去炉炭，用包铁的木棍将工件夹到砧上锤锻。如果锚重千斤左右，则架起木棚，许多人站在上面齐握铁链，联接锚身两端，其两端皆带大铁环，以便套在铁链上。将锚吊起来并转动，众人齐力将锚爪与锚身捶合起来。黏合的药不用黄泥，而是用筛细的旧墙土，一人不断将土撒在接口之中，一起与工件捶合，方无隙缝。在炉锤工序中，锚是最大的工件。



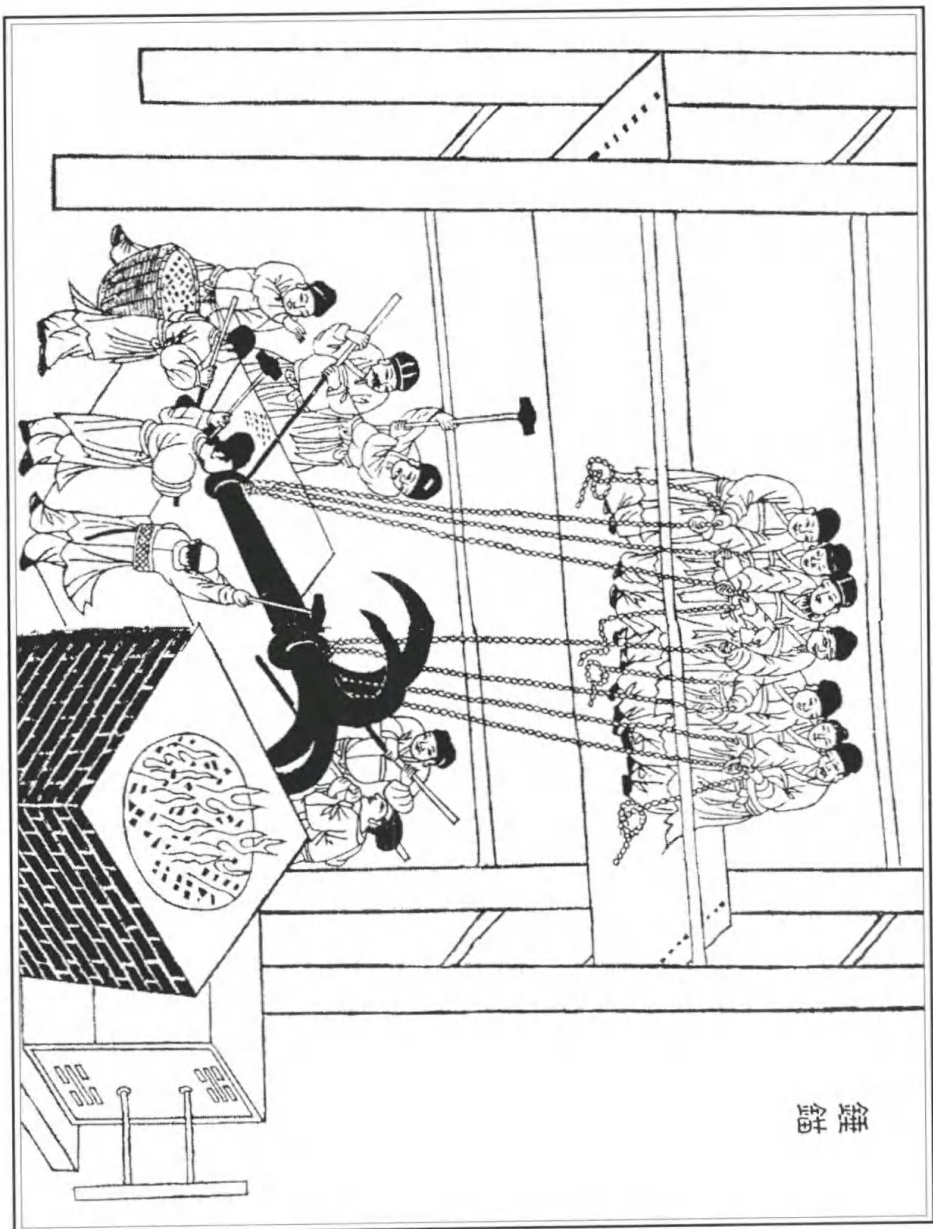
Chisels

Chisels are forged using wrought iron and have blades embedded with steel. The body is circular and hollow inside so that it can be installed with a wooden handle. (When a chisel is being made, an iron pipe should be made first as a mold called a "ram's head". The way is the same as that for making a handle of an iron spoon.) Hit the handle with an axe so that the chisel will be embedded in the wood. The chisel blade can be as wide as one *cun* or as thin as three *fen*. When being used to dig a round hole, the blade should be made into a columnar shape and it is then called scoop chisel.

Anchors

When it is difficult for ships to pull in to be berthed in storms, their fates lie with the anchors. Anchors of warships and sea boats weigh as many as a thousand *jin*. The method is to forge the four flukes first and then set them individually into the body of the anchor. For anchors weighing less than three hundred *jin*, put an anvil with a diameter of one *chi* beside the smelter. After the two ends of the anchor are burned hot, remove the charcoal. Then nip the item with sticks covered with iron onto the anvil to be hammered. If the anchor weighs around a thousand *jin*, a shed should be built. Many workers stand on the shed holding iron chains which connect to the two ends of the anchor body. There is one big hoop around each end to connect the chains so that the anchor could be suspended and turned. Everybody makes a concerted effort to hammer the flukes and the body together. Screened fine old calcimine instead of yellow mud is used as bond. One should spray the calcimine onto the interface constantly so that the

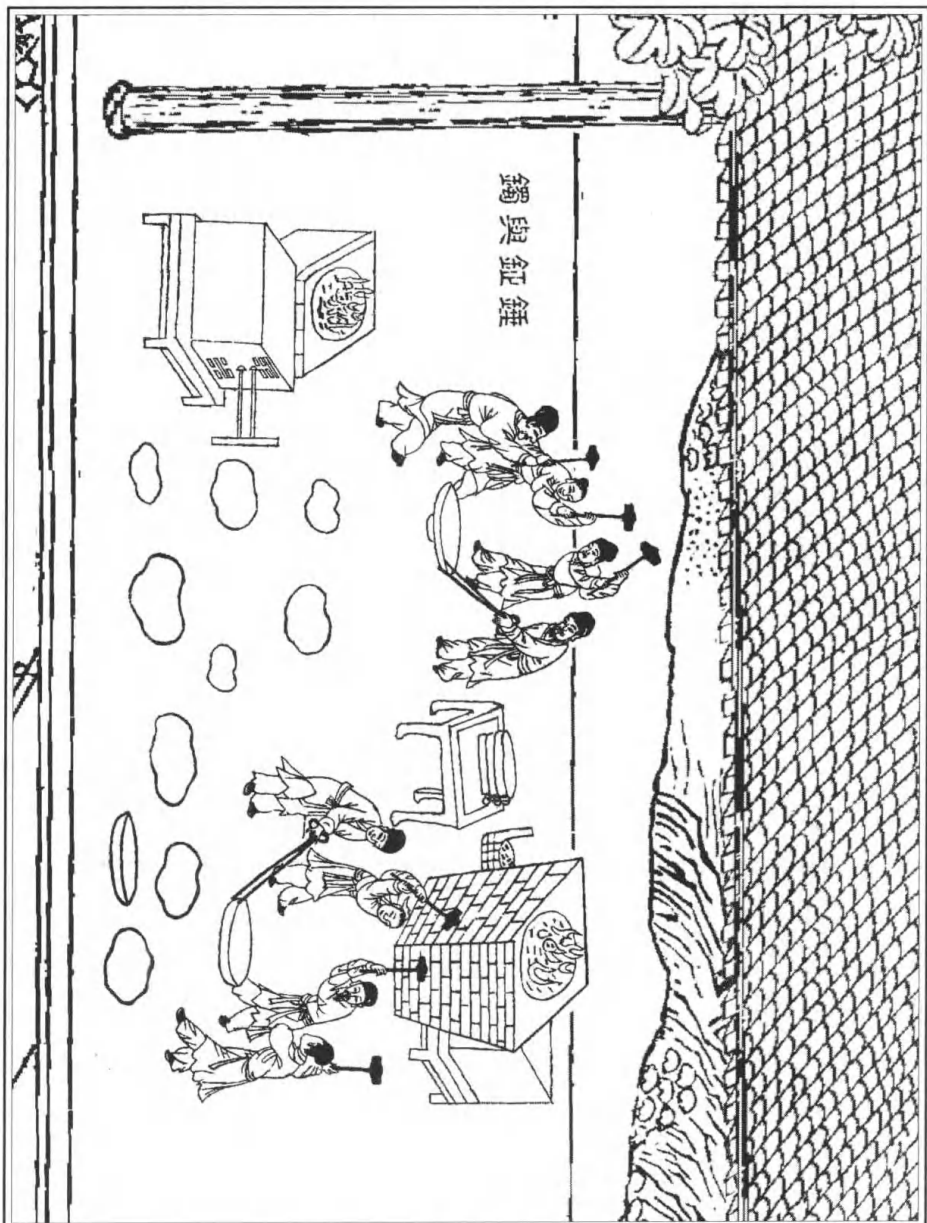
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Making the anchor





錫與鉦

First step in making gong and copper drum



【原文】

针

凡针先锤铁为细条，用铁尺一根锥成线眼，抽过条铁成线，逐寸剪断为针。先锉其末成颖，用小槌敲扁其本，钢锥穿鼻，复锉其外。然后入釜慢火炒熬。炒后以土末入松木火矢、豆豉三物掩盖，下用火蒸。留针二三口，插于其外以试火候。其外针入手捻成粉碎，则其下针火候皆足。然后开封，入水健之。凡引线成衣与刺绣者，其质皆刚。唯马尾刺工为冠者，则用柳条软针。分别之妙，在于水火健法云。

治 铜

凡红铜升黄而后熔化造器，用砒升者为白铜器，工费倍难，侈者事之。凡黄铜原从炉甘石升者，不退火性受锤。从倭铅升者，出炉退火性，以受冷锤。凡响铜入锡掺和成乐器者，必圆成无焊。其

【今译】

针

做针时先将铁锤成细铁条。另在一根铁尺上钻出小孔为线眼，将铁条从铁尺孔中抽出拉成铁线，再逐寸剪断铁线为针。先将一端锉成针尖，再用小锤将另一端打扁，以钢锥穿针鼻，更锉光其四周。然后放入锅中，用慢火炒之。炒后以土面、松木炭粉和豆豉三物掩盖，下部用火烧。留出二三根针插在外面以试火候。当外面的针能用手捻成粉时，说明下面的针火候已足。然后开封，入水中淬火。引线缝衣与刺绣用的针，质地均硬。只有福建马尾镇刺工做帽子用的针，是柳条软针。其软硬区别的妙处，在于火炒、淬火的的不同。

锻 铜

红铜要冶炼成黄铜，经熔化后才能制造器物。要是用砒霜升炼，便成为白铜器，工费倍增，奢侈的人才使用。原从炉甘石炼成的黄铜，熔后趁热锤打。加锌炼成的黄铜，出炉经冷却后锤打。以铜掺和锡炼成的响铜用来制成乐器的，必须是完整的工件，不能用几部分焊



worked pieces will be hammered together without any cracks. Anchors are the biggest items made with the hammering process.

Needles

First, hammer the iron into thin iron bars. On a draw-bench, drill small holes through which the iron bars can be drawn into iron threads. Then cut the threads by the *cun* into needles. File one end into a point and strike the other end flat with a small hammer. Drill the eye of the needle in the flat end with a steel awl and file the surrounding part slick. Then put the needles in a cauldron and roast them with slow fire. After this, cover them with earth, mixed with pine wood charcoal powder, and bean jam and heated from beneath. Set two or three needles outside to test the proper time and temperature. When the needles outside can be twiddled into powder by using fingers, it is time to uncover the needles underneath and to quench them in water. Needles for sewing clothes and embroidering are hard. Only needles for making hats by needle workers in Mawei Town in Fujian Province are “willow-branch soft needles”. The difference between hard and soft needles depends on whether the red-hot needles are quenched in water or cooled slowly in a dying fire.

Forging copper

Red copper should be smelted into yellow brass before being melted and made into implements. White brass is prepared by mixing copper with arsenic and other drugs, but its cost of production is twice that of other copper alloys and so only the extravagant undertake to manufacture it. Brass is smelted from calamine and should be stricken while it is still hot after being melted. Brass with zinc added should be



抽线琢针

Final Steps in Needle Making



抽线琢针

Final steps in needle making



【原文】

余方圆用器，走焊、炙火黏合，用锡末者为小焊，用响铜末者为大焊。（碎铜为末，用饭黏合打，入水洗去饭，铜末具存，不然则撒散。）若焊银器则用红铜末。

凡锤乐器，锤钲（俗名锣）不事先铸，熔团即锤。镛（俗名铜鼓）与丁宁，则先铸成圆片然后受锤。凡锤钲、镛皆铺团于地面，巨者众共挥力，由小阔开，就身起弦声，俱从冷锤点发。其铜鼓中间突起隆泡，而后冷锤开声。声分雄与雌，则在分厘起伏之妙。重数锤者其声为雄。凡铜经锤之后，色成哑白，受锉复现黄光。经锤折耗，铁损其十者，铜只去其一。气腥而色美，故锤工亦贵重铁工一等云。

【今译】

接而成。其余方形、圆形的器物，用锻焊或加热来黏合。小件用锡末为焊料，大件用响铜末为焊料。（将铜打碎成粉末，用米饭黏合后舂打。再加入水将饭洗去，铜末具存，不然铜末就会飞散。）若焊接银器，则用红铜末。

锻造乐器时，锤钲（俗名锣）不必先经铸造，将物料熔成一团后直接锤打。但锤镛（俗名铜鼓）与丁宁时，则要先铸成圆片，然后受锤。锤钲、镛时，要将铜料铺在地面上锤打。大件要数人合力锤打，由小逐渐摊开，冷锤锤打后，从被锻件那里发出乐声。铜鼓中间打出突起的圆泡，而后以冷锤定音。声调分为高与低，妙在铁锤起伏用力大小。重打数锤后，其声调低。铜经锤后呈白色而无光泽，锉后则复现黄色。锤打铜料时的损耗，是锤铁损耗量的十分之一。铜有腥味而色泽美观，故锻铜工匠收入比锻铁匠高一等。



stricken after being taken out of the smelters and cooled. Musical instruments are made with a mixture of tin and copper. The metal must be one piece and not solder. All round or square articles can be soldered over a flame. Small items use tin powder as welding materials while big ones use bronze powder. (Grind copper into powder and add cooked rice to hold it together before being pounded. Then wash the rice off with water so that the copper powder is left, or it will fly apart.) Red copper powder is used to solder silverware.

In instrument forging, a bell-shaped percussion instrument (commonly called gong) does not need to be cast in advance. It is stricken out of the smelt lumps of materials. Copper drum and “*dingning*” (a small bell), however, need to be cast into round slices before being hammered. For gong and copper drum, the copper materials should be placed on the ground to be stricken. Big items need several people to work together to hammer the lumps gradually bigger and bigger. When being hammered with cold hammers, forged parts make the sound of music. The raised part in the middle of the copper drum is made first, and then the article is cold-hammered to produce the proper sound. Tunes contain high and low tunes, depending on the forces of strikes by the hammers. After being beaten several times, the copper drums make low tunes. The slightest difference in the strokes will determine whether the sound will be male or female; the former is achieved with many repeated strokes of the hammer. Copper becomes dull white after being stricken and turns yellow again after being filed. Under hammering, the loss of copper is only one-tenth that of iron. Copper not only has an odor, but also has a beautiful color. That is why coppersmiths earn more than ironsmiths.



陶埏第十一

【原文】

宋子曰，水火既济而土合。万室之国，日勤一人而不足，民用亦繁矣哉。上栋下室以避风雨，而瓴建焉。王公设险以守其国，而城垣、雉堞，寇来不可上矣。泥瓮坚而醴酒欲清，瓦登洁而醢醢以荐。商周之际，俎豆以木为之，毋以质重之思耶。后世方土效灵，人工表异，陶成雅器，有素肌、玉骨之象焉。掩映几筵，文明可掬。岂终固哉！

瓦

凡埏泥造瓦，掘地二尺余，择取无沙黏土而为之。百里之内必产合用土色，供人居室之用。凡民居瓦形皆四合分片。先以圆桶为

【今译】

宋子说，通过水火交互作用，将黏土烧成陶器供人使用。古人说在有万户人家的地区内，一人勤于制陶无法满足需要，可见民间用陶器是很多的。房屋要避风雨，就要在房顶盖瓦。王公设险阻以保卫国家，要用砖修城墙和女墙，使来犯之敌攻不进来。坚实的陶瓮能使其中存放的美酒保持清香。洁净的高足杯适于盛供品作祭祀用。商周之际，祭器以木料制成，并非出于重视质朴的缘故，后来各地人争献奇技灵巧，使技术日新月异，因而制成优美的瓷器代替陶木制品。这些瓷器薄如纸，白如玉，摆在几案和宴会上，其美丽花纹和光亮色彩交相辉映，十分典雅。从这里可以看到事物怎么能是一成不变的呢？！

瓦

揉合黏土以造瓦，要掘地二尺多深，选择无沙的黏土作原料。方圆百里之内，一定能找到合用的黏土，供人建筑房屋之用。民房



Chapter 11

Ceramics

Songzi says that through the interaction of water and fire, clay can be burnt into ceramics. According to the ancients, within an area of ten thousand households, pottery made by one person is not enough for people's need. It is obvious that pottery is widely used among the folk. Roofs should be covered with tiles to make them weatherproof. Monarchs set dangers and obstacles to protect their countries. Walls and parapets should be made with bricks to keep enemy out. Strong earthen urns can keep the wine fragrant. Clean goblets are suitable to hold offerings for sacrifice. Between the Shang and Zhou dynasties, sacrificial dishes were made of wood. It is not because people love them, but because they lack the related skills. Later on, people of different places rushed to come up with better techniques. With the techniques changing with each passing day, wooden ware was replaced with polished pottery. Some of the pottery is as thin as paper, some is as white as white jade. These wares sparkle in quiet retreats or at festive boards, a concrete sign of civilized life. So from this, how can we say that things are the same all the time?

Tiles

When people knead clay to make tiles, it is necessary to dig two *chi* deep under the earth's surface and choose clay without sand as the source material. Within a hundred *li* there must be clay suitable for



【原文】

模骨，外画四条界。调践熟泥，叠成高长方条。然后用铁线弦弓，线上空三分，以尺限定，向泥爪平戛一片，似揭纸而起，周包圆桶之上。待其稍干，脱模而出，自然裂为四片。凡瓦大小，向无定式，大者纵横八九寸，小者缩十之三。室宇合沟中，则必需其最大者，名曰沟瓦，承受淫雨不溢漏也。

凡坯既成，干燥之后则堆积窑中，燃薪举火。或一昼夜或二昼夜，视窑中多少为熄火久暂。浇水转釉与造砖同法。其垂于檐端者有滴水，下于脊沿者有云瓦，瓦掩覆脊者有抱同，镇脊两头者有鸟兽诸形象。皆人工逐一作成，载于窑内，受水火而成器则一也。

若皇家宫殿所用，大异于是。其制为琉璃瓦者，或为板片，或为宛筒，以圆竹与斫木为模，逐片成造。其土必取于太平府（舟运三千里方达京师。掺沙之伪，雇役、掳船之扰，害不可极。即承天皇陵亦取于此，无

【今译】

用瓦的瓦坯都是四片合在一起，再分成单片。先用圆桶作骨模，桶外画出四条等分线。把黏土调和好，踩成熟泥，堆成高的长方形。再用铁线作弓弦，线上留出三分厚的空隙，线长限定一尺，用铁线向黏土墩直切，切出一片，像揭纸那样将其揭起，将此片泥土围在圆筒模上。待其稍干，脱模而出，自然裂成四片。瓦的大小向来无固定格式，大的纵横八九寸，小的则缩小十分之三。房顶的流水沟，必须用最大的瓦，名曰沟瓦，能承受淫雨而不溢漏。

瓦坯既成，干燥之后就堆积在窑中，点火烧柴。或烧一昼夜，或二昼夜，看窑中物料多少而决定何时熄火。浇水转釉的方法与造砖相同。垂在房檐端上的瓦叫“滴水瓦”，房脊两边的瓦叫“云瓦”，覆盖房脊的叫“抱同瓦”，房脊两头的瓦装有鸟兽形象。这些瓦同样都要逐件做成坯，放入窑中受水火作用烧成。

皇家宫殿所用的瓦，与民用瓦大不相同。宫殿瓦的形式是琉璃瓦，或者是板片形，或者是圆筒形，用圆竹与加工的木料作模骨，逐片烧造。土质必取自太平府（船运三千里，方达北京。承运的官吏，有掺沙作伪的，有强雇民工、抢夺民船的，害人至极。修建承天皇陵也用这种土，没



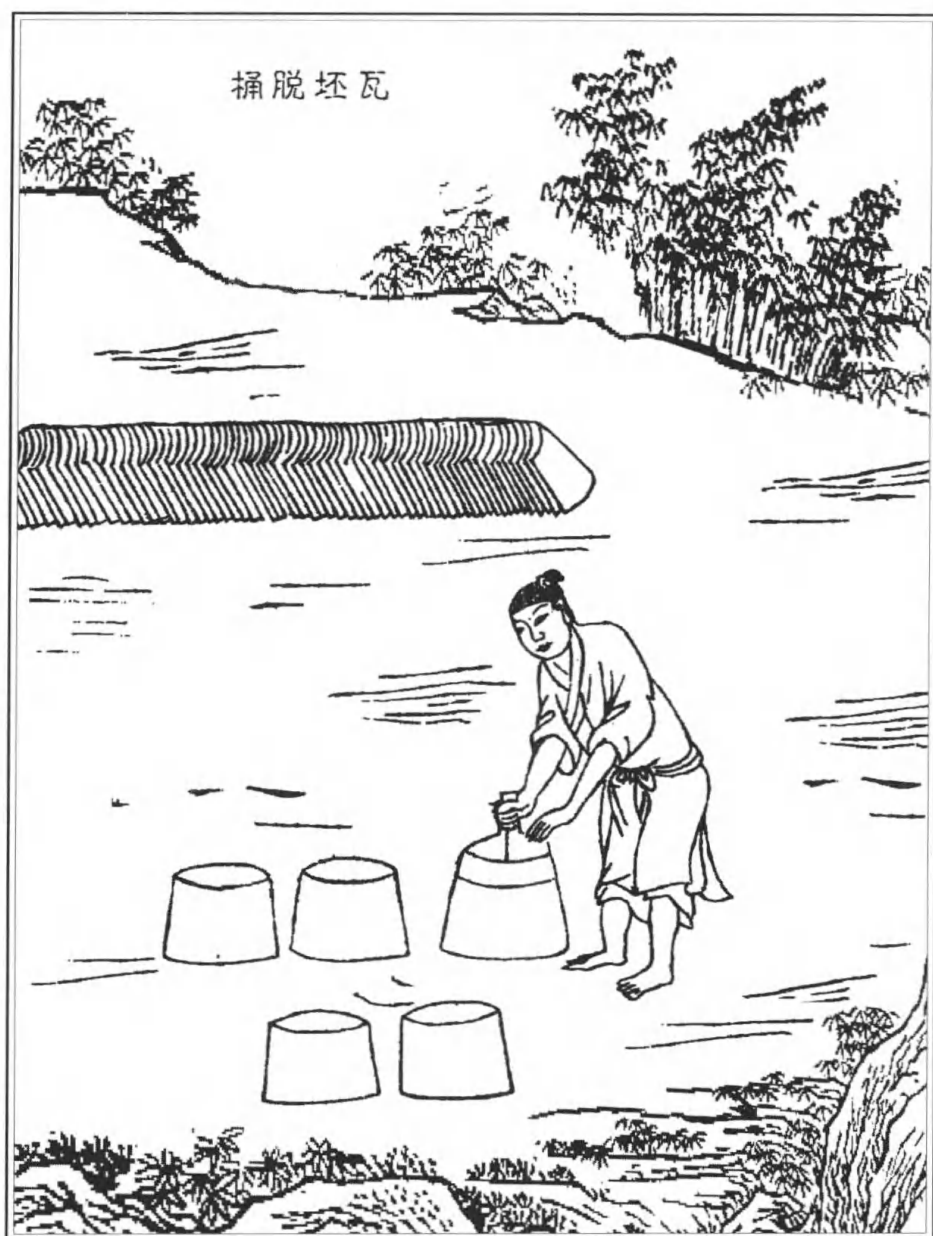
building houses. Earthen bricks of tiles for ordinary people are all made from the quarter sections of a cylinder. Prepare a cylindrical core mold, on the surface of which are four ribbed demarcation lines. The clay is mixed with water and made into a high rectangular pile. Then the moist clay pile is sliced by the iron wire of a bow, with the wire located at 3 *fen* away from the back of the bow. The sliced clay layer is lifted like a piece of paper, and wrapped around the cylindrical core mold. When it is a little dried, the clay is removed from the mold, and naturally falls apart into four pieces. The size of tiles is not fixed, a large one can be eight or nine *cun* both in length and width, while a small one can be three tenths of the large one. Gutter-ways on a roof must be made with the largest tiles in order to stand storms.

When the earthen tiles are ready, stack them in a kiln and light firewood. It takes a day and night or two days and two nights depending on the number of bricks in the kiln. The way of watering and turning round glaze is the same as making bricks. Tiles hanging on the eaves are called drip tiles; tiles beside the ridge are called cloud tiles, while tiles covering the ridge are called *Baotong* tiles, and tiles on either ends are fixed with sculptures of birds or beasts. These tiles are all made by making semi-finished tiles first and putting them in the kiln; they will form shapes as a result of the interaction between fire and water.

Tiles used for royal palaces are much different from those used for ordinary people's houses. They are all glazed roof tiles. Some have the shape of boards; some have the shape of cylinders which are made by using round bamboo or polished wood molds and burning them one by one. Clay must come from the prefecture of Taiping (This type of clay was transported 3,000 *li* to Beijing. In the course of transportation work officials in charge



造瓦坯
Making tiles



瓦坯脱桶
Separating tiles from the mold



【原文】

人议正)。造成，先装入琉璃窑内，每柴五千斤烧瓦百片。取出成色，以无名异、棕榈毛等煎汁涂染成绿，代赭石、松香、蒲草等涂染成黄。再入别窑，减杀薪火，逼成琉璃宝色。外省亲王殿与仙佛宫观间亦为之，但色料各有配合，采取不必尽同。民居则有禁也。

砖

凡埏泥造砖，亦掘地验辨土色，或蓝或白，或红或黄（闽广多红泥，蓝者名善泥，江浙居多），皆以黏而不散，粉而不沙者为上。汲水滋土，人逐数牛错趾，踏成稠泥。然后填满木框之中，铁线弓戛平其面，而成坯形。

凡郡邑城雉、民居垣墙所用者，有眠砖、侧砖两色。眠砖方长条，砌城郭与民人饶富家，不惜工费，直叠而上。民居算计者，则一

【今译】

有人敢议论)。瓦坯造成后，装入琉璃窑中。每用柴五千斤，烧成瓦片一百片。烧后取出挂色，以无名异、棕榈毛等煎汁涂染成绿色，以代赭石、松香、蒲草等染成黄色。再装入另外的窑中，减少薪火缓烧成具有琉璃光泽的美丽颜色。外省亲王殿与佛寺、道教寺院，也有用琉璃瓦的，但釉料各有配方，制法不完全相同。民房则禁止用琉璃瓦。

砖

揉合黏土造砖，也要掘地辨别土色。黏土有蓝、白、红、黄几色（福建、广东多红泥，蓝色的叫善泥，江浙较多），均以黏而不散、粉细而不含沙粒的为上料。汲上水来将黏土滋润，驱赶几头牛践踏，踏成稠泥。然后将泥填满在泥造砖坯木框之中，用铁线弓刮平其表面而形成泥坯。

城邑的城墙与民房墙壁所用的砖有眠砖、侧砖两种。眠砖为长方形，用以砌城墙和富家民居的墙壁，不惜工费，一直砌上去。精打细算的居民建房，则在一排眠砖之上砌一排侧砖，侧砖中间以土石填实，这是为了节约。除墙砖以外，铺地面的叫方墁砖。屋椽上用以承



added some sand in the clay and forced the laborers to do the work. The imperial mausoleum of the Ming Dynasty was built with this type of clay. No one dared say something about it). After the semi-finished bricks are ready, put them in a glazed-tile kiln. Every hundred pieces of tiles require five thousand *jin* of firewood. Take them out to paint after burning. Water of decocting leaves of manganese black and palm can dye them green, while ochre, rosin and aquatic grass can dye them yellow. Put the painted tiles in another kiln again, reduce the firewood and burn them slowly. Thus the tiles can have the beautiful colors of glazed roof tiles. Occasionally this kind of tiles is used in the palaces of princes living in the provinces as well as in temples and monasteries, although the materials and methods of glazing may be a little bit different from one place to another. However, glazed roof tiles are forbidden in the construction of houses for the ordinary people.

Bricks

When people knead clay to make bricks, it is also necessary to get clay from the ground. Clay can be blue, white, red and yellow (Fujian and Guangdong provinces are rich in red clay and Zhejiang Province teems with blue clay, which is called "good clay"). The best clays are those that are adhesive but not loose, fine and without sand. To make bricks, first get water from a well and moisten the clay. Then drive several cattle to tread on the clay until the clay becomes a thick paste. Finally fill the thick paste in a wooden frame, scrape its surface with a wire-strung bow to form unbaked bricks.

Bricks used to make walls of towns and walls of ordinary people's houses are solid bricks or hollow bricks. The solid bricks are oblong pieces and are used to build rampart walls and walls of rich people's



【原文】

眠之上施侧砖一路，填土砾其中以实之，盖省啬之义也。凡墙砖而外，甃地者名曰方漫砖。榱桷上用以承瓦者曰榱板砖。圆鞠小桥梁与圭门与窀穸墓穴者曰刀砖，又曰鞠砖。凡刀砖削狭一偏面，相靠挤紧，上砌成圆。车马践压不能损陷。造方漫砖，泥入方框中，平板盖面，两人足立其上，研转而坚固之，烧成效用。石工磨斫四沿，然后甃地。刀砖之值视墙砖稍溢一分，榱板砖则积十以当墙砖之一，方漫砖则一以敌墙砖之十也。

凡砖成坯之后，装入窑中。所装百钧则火力一昼夜，二百钧则倍时而足。凡烧砖有柴薪窑，有煤炭窑。用薪者出火成青黑色，用煤者出火成白色。凡柴薪窑巅上侧凿三孔以出烟。火足止薪之候，泥固塞其孔，然后使水转釉。凡火候少一两，则釉色不光。少三两则名嫩火砖，本色杂现，他日经霜冒雪则立成解散，仍还土质。火

【今译】

瓦的叫榱板砖。砌圆拱形小桥、拱门与墓穴的叫刀砖，又叫鞠砖。刀砖是将其一边削窄，相靠挤紧，砌上一个圆形。车马践压时不致损坏坍塌。造方漫砖时，将泥放入方框之中，上面盖以平板，两人站在上面踏转，将泥踏实，烧成后使用。由石工磨削其四边，然后铺在地面上。刀砖比墙砖稍贵一些，榱板砖比墙砖便宜十倍，而方漫砖又比墙砖贵十倍。

造成砖坯之后，将其装入窑中。装三千斤要烧一昼夜，六千斤则必须用二倍时间才够。烧砖有的用柴薪窑，有的用煤炭窑。柴窑烧出的砖呈青、黑色，用煤则烧出砖成白色。柴薪窑顶上偏侧要凿三个孔，用来出烟。到烧好该停止加柴时，就用泥固塞其孔，然后浇水转釉。如火候少一成，则釉色不光。少三成则叫嫩火砖，出现原来坯土颜色，日后一经霜雪则很快松散，又变成泥土。火候多一



houses, the bricks being placed solidly one upon another. But economical people lay a tier of hollow bricks between two tiers of solid bricks and they also fill the hollow bricks with earth and stone. In addition to building walls, bricks used to pave the ground are called “square frame bricks”. Bricks used to hold tiles on rafters are called Huangban bricks. Bricks used to build vaulted bridges, archways and graves are called knife bricks or curved bricks. One side of the knife bricks is cut off wedgewise. When they are packed closely together to form an arch, the struture will not collapse and can stand the great stress of chariots. When making “square frame bricks”, put clay in a frame and cover it with a flat board. Two persons stand on the board in order to pack the mass and ensure the solidity of the unbaked brick. They can be used after burning. Stone workers grind the four sides, and pave them on the ground. Knife bricks are a little more expensive than wall bricks; Huangban bricks are ten times cheaper than wall bricks, while “square frame bricks” are ten times the cost of wall bricks.

After the unbaked bricks are made and dried, they are put into a kiln and are fired. It takes one day and night for every three thousand *jin* of bricks, so if there are six thousand *jin* in the kiln, it takes two days and two nights. Fuel for firing bricks can either be firewood or coal. Bricks fired by using firewood will be bluish gray in color, while bricks fired by using coal are white in color. Make three holes on the side top of the firewood kiln to let smoke out. When the firing is finished and the fire is withdrawn, these holes are sealed with mud, and then water is used for the superficial glazing on quenching of the bricks. If bricks are not heated enough, lacking in one tenth time of firing, glaze colors will not be bright; if bricks lack three tenths time of



【原文】

候多一两则砖面有裂纹。多三两则砖形缩小拆裂，屈曲不伸，击之如碎铁然，不适于用。巧用者以之埋藏土内为墙脚，则亦有砖之用也。凡观火候，从窑门透视内壁，土受火精，形神摇荡，若金银熔化之极然，陶长辨之。

凡转釉之法，窑巔作一平田样，四围稍弦起，灌水其上。砖瓦百钧用水四十石。水神透入土膜之下，与火意相感而成。水火既济，其质千秋矣。若煤炭窑视柴窑深欲倍之，其上圆鞠渐小，并不封顶。其内以煤造成尺五径阔饼，每煤一层，隔砖一层，苇薪垫地发火。若皇家居所用砖，其大者厂在临清，工部分司主之。初名色有副砖、券砖、平身砖、望板砖、斧刃砖、方砖之类，后革去半。运至京师，每

【今译】

成则砖面有裂纹。多三成则砖形缩小、破裂，弯曲不直，击之如碎铁，不适于用。巧用者将其埋藏于土内作墙脚，也有砖的作用。观火候从窑门看到内壁。黏土受火的作用，呈摇荡的形态，像金银熔化时那样。这要靠陶工师傅来辨别。

浇水转釉之法，是在窑顶开个平面，四边稍高出一点，在上面浇水。砖瓦三千斤用水四十石。水气透入土窑之内，与窑内火气相互作用。借水火作用，制成坚固耐用的砖。煤炭窑比柴窑高二倍，其上部的圆拱逐渐缩小，并不封顶。窑内放直径一尺五寸的煤饼，每放一层煤，就放一层砖，下面垫芦苇或柴草以便点火燃烧。皇室所用的砖，生产大砖的砖厂在山东临清，工部设派出机构掌管。最初定的名目有副砖、券砖、平身砖、望板砖、斧刃砖、方砖之类，后来削去一半。这类砖运到北京，每艘运粮船搭四十块，民船载二十块。铺正殿的细



firing, they are called slight fire bricks, the color of which appears similar to that of their original unbaked bricks. When exposed to frost and snow, they will quickly loosen and become clay again. On the other hand, if bricks are fired one tenth of the firing time longer, there will be cracks on the surface of the bricks; if the bricks are fired three tenths of the firing time longer, they will be bent and shrink. Such bricks fracture and are easily smashed, unsuitable for use. Clever builders bury them underground as foundations for walls at the foot of the walls, which also have the function of bricks. The method used to check the temperature in the kiln is to watch through the door of the kiln to its inside to see if bricks are fired enough. Under the attack of fire the clay appears to sway and in a state similar to gold and silver at their melting point. The firemen of pottery works will recognize the proper temperature.

The way of watering and turning round the glaze is to open a hole on the top of the kiln, with its four sides a little higher, and pour water into it. Every three thousand *jin* of bricks or tiles need forty *dan* of water. Hydrosphere permeates into the kiln and interacts with fire inside the kiln. As a result of the interaction of fire and water, strong and durable bricks are made. A coal kiln is two times higher than a firewood kiln, with the upper arch contracting gradually, but not closed. Inside the kiln, lay coal cakes one *chi* and five *cun* in diameter. Lay a tier of bricks between every two tiers of coal cakes. Lay reeds and firewood at the bottom in order to light easily. Brickyards which produce big bricks and bricks for royalty are located in Linqing of Shandong Province, and the Ministry of Works in feudal China dispatched certain organisation to manage them. Previously many different types of bricks were produced here, such as "secondary brick", "tally brick", "flat-



泥造砖坯

Making earthen bricks

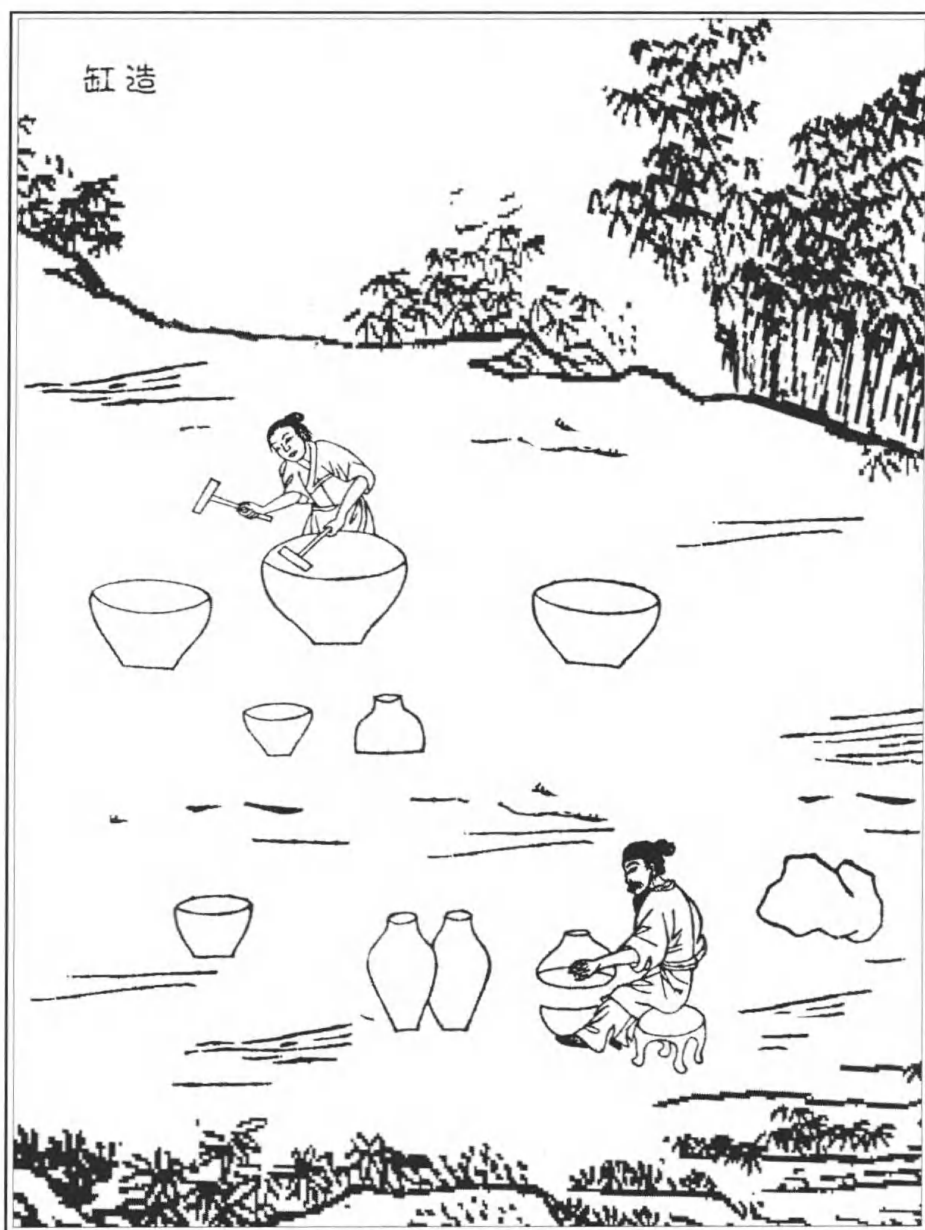


磚瓦澆水轉軸

Superficial glazing of bricks and tiles by water quenching



煤炭烧砖窑
Coal-fired brick kiln



造缸
Making large jars



【原文】

漕舫搭四十块，民舟半之。又细料方砖以甃正殿者，则由苏州造解。其琉璃砖色料已载《瓦》款。取薪台基厂，烧由黑窑云。

罍、瓮

凡陶家为缶属，其类百千。大者缸瓮，中者钵盂，小者瓶罐，款制各从方土，悉数之不能。造此者必为圆而不方之器。试土寻泥之后，仍制陶车旋盘。功夫精熟者视器大小掐泥，不甚增多少。两人扶泥旋转，一掐而就。其朝廷所用龙凤缸与南直花缸，则厚积其泥，以俟雕镂，作法全不相同。故其值或百倍，或五十倍也。

凡罍缶有耳嘴者皆另为合上，以釉水涂粘。陶器皆有底，无底者则陕西炊甑用瓦不用木也。凡诸陶器精者中外皆过釉，粗者或釉

【今译】

料方砖，则由苏州烧造北运。至于琉璃砖，釉料已载于《瓦》条。其燃料来自北京台基厂，烧造在黑窑厂。

罍、瓮

陶工所做的腹大口小的器皿，种类很多。大的有缸、瓮，中等的有钵、盂，小的为瓶、罐。各地款式不同，不能尽数。所造出的这类器皿都是圆形，而非方形。调查土质、选定泥土后，要用陶车旋盘。技术熟练的根据器物大小取泥，不需增添多少泥，两人扶泥、旋转，一掐即成。朝廷所用龙凤缸与南直隶的花缸，则厚积其泥，以待雕镂花纹，与一般的缸制法不同，因此其价钱要高出五十倍或百倍。

瓶和腹大口小的器皿有耳、嘴的，都要另外接合，以釉水粘住。陶器都有底，无底的则是陕西蒸饭的甑，用瓦制而不用木制。各种



bodied brick", "lookboard brick", "axe-blade brick", "square brick", and so forth, but half of these bricks were eliminated later. When shipping these bricks to Beijing, every ship carrying food supplies can only carry forty bricks, and every privately owned ship can carry twenty bricks. Fine-grained square bricks used for paving main halls are produced in Suzhou and shipped north. As for glazed roof bricks, their glaze is already mentioned in Tiles. The fuel comes from Taiji factory in Beijing and fired in the Black kiln factory.

Water Jars and the Like

Many utensils made by potters have a big paunch and a small opening. There are big utensils, such as heavy water jars; medium utensils, such as bowls; and small utensils, such as vases. Their shapes and sizes are different according to the locality; they can not be listed in a detailed way here. All of these utensils are round, not square. After identifying the clay and deciding on the clay, use a potter wheel to spin the disk. The experienced potter can measure with his eyes the amount of clay needed for an article and are able to take almost that amount into his hands, and, with the help of another person, place it on the revolving potter's wheel, then with one single molding the article is completed. However, the large "dragon and phoenix jars" which are used in the Imperial Court, and the large figured jars of South Chili Province are made by a completely different method: the clay is allowed to form very thickly over the body of the jar, so that figures and designs can be carved on the wares. This is why the price of such jars is fifty or one hundred times higher than that of ordinary jars.

Ears and mouths on bottles and utensils with big paunches and small openings are made separately and then affixed to the body by a



【原文】

其半体。唯沙盆、齿钵之类，其中不釉，存其粗涩以受研播之功。沙锅、沙罐不釉，利于透火性以熟烹也。凡釉质料随地而生，江、浙、闽、广用者蕨蓝草一味。其草乃居民供灶之薪，长不过三尺，枝叶似杉木，勒而不棘人。陶家取来燃灰，布袋灌水澄滤，去其粗者，取其绝细。每灰二碗掺以红土泥水一碗，搅令极匀，蘸涂坯上，烧出自成光色。北方未详用何物。苏州黄罐釉亦别有料。唯上用龙凤器则仍用松香与无名异也。

凡瓶窑烧小器，缸窑烧大器。山西、浙江各分缸窑、瓶窑，余省则合一处为之。凡造敞口缸，旋成两截，接合处以木椎内外打紧。匝口坛、瓮亦两截，接内不使用椎，预于别窑烧成瓦圈，如金刚圈形，托印其内，外以木椎打紧，土性自合。

【今译】

陶器中，精的内外都过釉，粗的或釉其半体。只有沙盆、齿钵之类，里面不上釉，使内壁保持粗涩，以便研磨。沙锅、沙罐也不上釉，利于传热以熟煮食物。釉料到处都出产，江苏浙江、福建、广东所用的有一种蕨蓝草，这种草是居民烧饭的燃料，长不过三尺，枝叶像杉树，以手勒之而不棘人。陶工取来燃薪，将其灰放布袋内，注水澄滤，去掉其中粗粒，取其绝细的。每灰二碗混以红土泥水一碗，搅拌得十分均匀，涂蘸在坯料上，烧出后自成釉的光色。北方不知用何物作釉料，苏州的黄罐所用釉也是另外的原料。但上供朝廷的龙凤缸，则以松香与无名异为釉料。

瓶窑用来烧小件器皿，缸窑则烧大的器皿。山西、浙江分别设缸窑、瓶窑，其余各省则将两窑合在一起。造敞口缸时，转动陶车将泥坯旋成上下两截，再接合起来。接合处以木槌内外打紧。做窄口的坛、瓮也先制成两截，但接合内部时不使用槌打。可先在另外的窑内烧成瓦圈，像金刚圈那样的形状，承托其内部，外面以木槌打紧，泥坯自然黏合。



liquid glaze. Pottery has a bottom, that without a bottom is called a steamer which is used in Shaanxi Province to steam food: it is made with tiles, not wood. Refined pottery is glazed both outside and inside, while the roughly made ones are half glazed. Only pans made from clay and sand and earthen bowls are not glazed inside to keep their inside rough and astringent, in order to grind easily. Vats and jars made of clay and sand are also not glazed to keep them able to conduct heat easily to cook food. Glazes are produced everywhere, Jiangsu, Zhejiang, Fujian and Guangdong provinces make them from *Pleris serrulata*. *Pleris serrulata* is used as a fuel to cook, which is less than three *chi* long, its leaves look like cedar leaves, but do not prick hands. Potters burn it and put the ash in a hop-pocket, pour water into the pocket and wash the ash, in order to remove big ash, leaving only the fine one. Blend every two bowls of ash with a bowl of red clay water and stir them. Spread it on earthen bricks and there will be light glaze color after fired. The source material of glazes in the north is not known, and the source material of glazes in Suzhou, which is used when making yellow jars, is also different. However, glazes for “dragon and phoenix jars” for the court are made from manganese black and palm.

A flask kiln is used to make small utensils, while a vat kiln is used to fire big utensils. Shanxi and Zhejiang provinces built vat kilns and flask kilns separately, while other provinces combine the two together. When making a big opening vat, turn the wheel to divide the earthen bricks into two and connect them again later. Knock the inside and outside of the connection with a mallet. Divide earthen bricks into two as well when making jugs and urns with small openings, but there is no need to knock the connection inside. Fire the earthenware rings in another kiln at first to underpin the inside; knock the outside with the mallet, and the earthen bricks will stick together naturally.



【原文】

凡缸窑、瓶窑不于平地，必于斜阜山冈之上，延长者或二三十丈，短者亦十余丈，连接为数十窑，皆一窑高一级。盖依傍山势，所以驱流水湿滋之患，而火气又循级透上。其数十方成陶者，其中若无重值物，合并众力众资而为之也。其窑鞠成之后，上铺覆以绝细土，厚三寸许。窑隔五尺许，则透烟窗，窑门两边相向而开。装物以至小器，装载头一低窑；绝大缸瓮，装在最末尾高窑。发火先从头一低窑起，两人对面交看火色。大抵陶器一百三十斤费薪百斤。火候足时，掩闭其门，然后次发第二火，以次结竟至尾云。

白 瓷

凡白土曰垩土，为陶家精美器用。中国出唯五六处，北则真定州、平凉华亭、太原平定、开封禹州，南则泉郡德化（土出永定窑在德化）、徽郡婺源、祁门（他处白土陶范不黏，或以扫壁为埴）。德化窑唯以

【今译】

缸窑、瓶窑都不在平地上，必建在斜坡山冈上，较长的可达二三十丈，短的亦有十余丈长。连接几十个窑，一窑高过一窑。因为各窑顺着山坡分布，可驱流水以免潮湿之患，而火力又可循级透上。数十窑烧成的陶器，其中虽然没有什么昂贵的东西，但也是集合大量人力、物力而造出来的。窑的圆顶建成后，上面铺上三寸厚的极细的土。窑上每隔五尺开一烟窗，窑门在两侧相向而开。小的器物装入最下面的窑，特大的缸、瓮装在最后面的高窑。烧窑先从头一个低窑开始，两人面对面观察火候。大约烧陶器一百三十斤，费柴百斤。火候足时，关闭窑门。然后依次在第二个窑门点火，这样逐级一直烧到最后一窑。

白 瓷

白陶土或曰垩土，是陶工烧制精美瓷器所用的原料。中国只有五六个地方出产垩土。北方有真定府定州、甘肃平凉府华亭县、山西太原府平定县、河南开封府禹县。南方则有福建泉州府德化县（土出自永定县，窑设在德化）、徽州府婺源县、祁门县（别处的白土做陶坯不黏结，可用以粉刷墙壁）。德化窑只是烧造瓷仙女、精巧人物和玩器，



Both vat kilns and flask kilns are not built on level ground, but along hilly slopes, with twenty or thirty *zhang* as the longest one and over ten *zhang* as the shortest. Dozens of kilns are connected together, with the next one higher than the former one. As kilns are built along the slopes, water can run down to avoid moisture while fire can climb up gradually. Pottery fired in these kilns is not rare and expensive, but it takes a lot of manpower and material resources. When the brick kilns are completed, their tops are covered with a three-inch layer of fine earth. The walls of each individual kiln are equipped not only with windows to let smoke out every five *chi*, but also with a double door that opens from the middle. Small utensils should be put in the bottom kilns and big utensils, like vats and urns, should be put in the top kilns. Light the kiln from the lowest with two men sitting opposite watching the fire to decide whether it is fired enough. About every hundred and thirty *jin* of pottery needs one hundred *jin* of firewood. When the fire is strong, close the doors. Then light the second kiln, and so on, until the last kiln is fired.

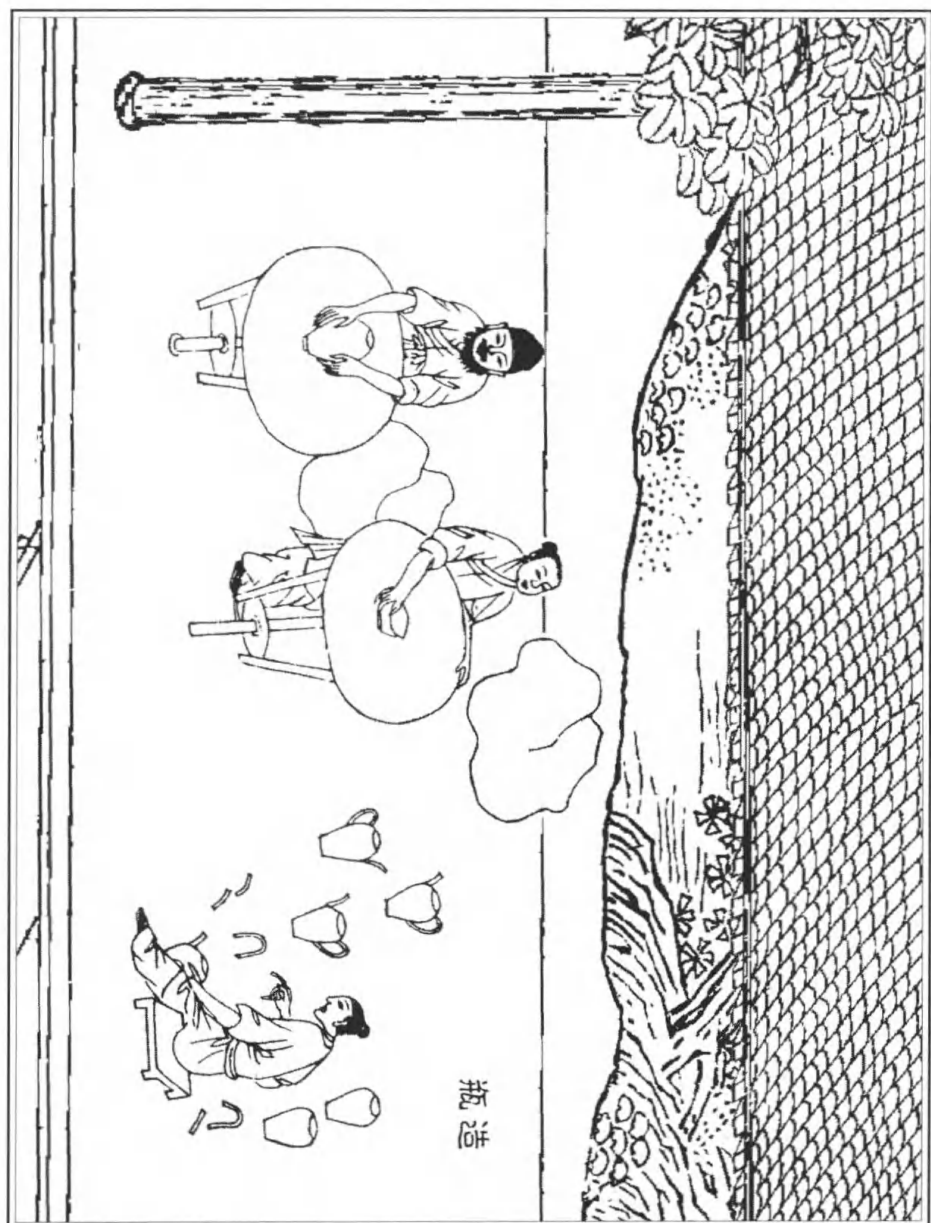
White Porcelain

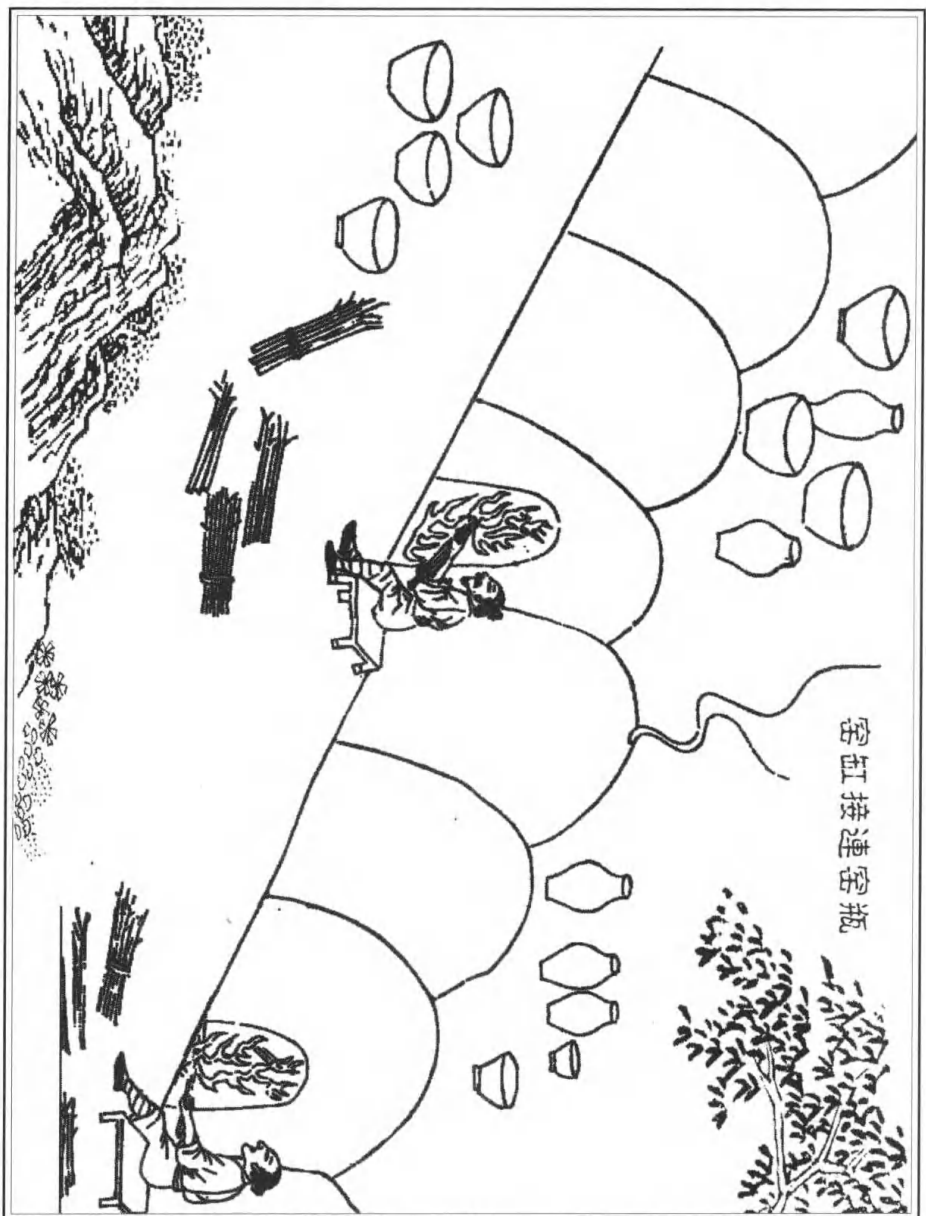
White soil known as white clay is the raw material used by porcelain makers for their finest wares. There are five or six areas producing white clay. In the north, there are Dingzhou of the Zhending Prefecture, Huating County of the Pingliang Prefecture in Gansu Province, Pingding County of Taiyuan in Shanxi Province, and Yu County of the Kaifeng Prefecture in Henan Province. In the south, there are Dehua County (the producing area is Yongding County, but the kiln is in Dehua) of Quanzhou in Fujian Province, Wuyuan County of the Huizhou



Making bottles or small jars

造瓶





瓶窑连接缸窑

Bottle kilns inter-connected to jar kilns



【原文】

烧造瓷仙、精巧人物、玩器，不适实用。真、开等郡瓷窑所出，色或黄滞无宝光。合并数郡，不敌江西饶郡产。浙省处州丽水、龙泉两邑烧造过釉杯碗，青黑如漆，名曰处窑。宋元时龙泉琉华山下有章氏造窑，出款贵重，古董行所谓哥窑器者即此。

若夫中华四裔驰名猎取者，皆饶郡浮梁景德镇之产也。此镇从古及今为烧器地，然不产白土。土出婺源、祁门二山。一名高梁山，出粳米土，其性坚硬。一名开化山，出糯米土，其性粢软。两土和合，瓷器方成。其土作成方块，小舟运至镇。造器者将两土等分入臼舂一日，然后入缸水澄。其上浮者为细料，倾跌过一缸。其下沉底者为粗料。细料缸中再取上浮者，倾过为最细料，沉底者为中料。既澄之后，以砖砌长方塘，逼靠火窑，以借火力。倾所澄之泥于中吸干，然后重用清水调和造坯。

凡造瓷坯有两种。一曰印器，如方圆不等瓶、瓮、炉、盒之类，

【今译】

不切实用。真定府、开封府等瓷窑所产，间或色黄，呆滞而无光。合并上述数地，都敌不过江西饶州府所产。浙江处州府丽水、龙泉两县，烧造过釉的杯、碗，色青黑如漆，名曰处窑。宋、元时，龙泉的琉华山下有章氏造窑，出品贵重，古董行所谓哥窑瓷器就指此而言。

中国驰名四方、人们竞相购取的，都是饶州府浮梁县景德镇的产品。此镇从古至今就是烧瓷器的地方，但当地不产白土。白土来自婺源、祁门的两座山。其一叫高梁山，出粳米土，土性坚硬。另一座山叫开化山，出糯米土，土性黏软。将两种土掺和才能制成瓷器。瓷土做成方块，用小船运到景德镇。造瓷器者将两种土等分配合，放入臼中舂一天，再在缸中以水澄清。浮在上面的为细料，倒在另一缸中。下沉底的为粗料。放细料的缸中再取出浮在上面的，为最细料，沉底的为中料。澄清后，以砖砌成长方形的塘，将澄好的泥倒入塘内。塘紧靠近火窑，借窑内火力将泥吹干，再重新用清水调和制坯。

做瓷的坯有两种。一种叫印器，如兼有方圆形的瓶、瓮、炉、盒之类，宫中所用的瓷屏风、烛台之类。先用黄泥塑成印模，模具或左



Prefecture and Qimen County. (White clay in other places is not sticky enough to make pottery, but it can be used to paint walls.) The Dehua kilns only make porcelain fairies, delicate figures and toys, which are not practical. Some porcelain made in Zhending and Kaifeng Prefecture is a little yellow and dull. The above-mentioned porcelain can not match the porcelain made in the Raozhou Prefecture of Jiangxi Province. Lishui and Longquan County of Chuzhou Prefecture in Zhejiang Province make glazed cups and bowls, which are named the Chu kiln and black as black lacquer. During the Song and Yuan dynasties, at the foot of Liuhua Mountain in Longquan there was Zhangshi kiln, which turned out precious porcelain. This is the Brother kiln mentioned in antique business.

Jingdezhen porcelain produced in Liang County of Raozhou Prefecture is the most famous and popular throughout the country. Jingdezhen is the place producing porcelain from ancient times, but white clay doesn't exist in Jingdezhen, it comes from Wuyuan and Qimen. One is called Gaoliang Mountain, which yields hard rice clay; the other is called Kaihua Mountain, which yields soft glutinous rice clay. By mixing these two kinds of clay together, porcelain can be made. Clay is made into blocks and shipped to Jingdezhen by boat. Porcelain makers mix the same amount of the two kinds of clay, pound them in a mortar for a day and settle them with water in a vat. The small quantity of powder floating on the surface is fine material and should be poured into another vat. The one settling at the bottom is rough material. The fine material in the latter vat should be taken out and poured into another vat. The material floating on the surface of the small quantity powder vat, it is the best, and the material at the bottom is the next. After settling, dry by fire in the kiln and mix them with water again to make unburnt bricks.



造瓷圓器

Shaping clayware with potter's wheel



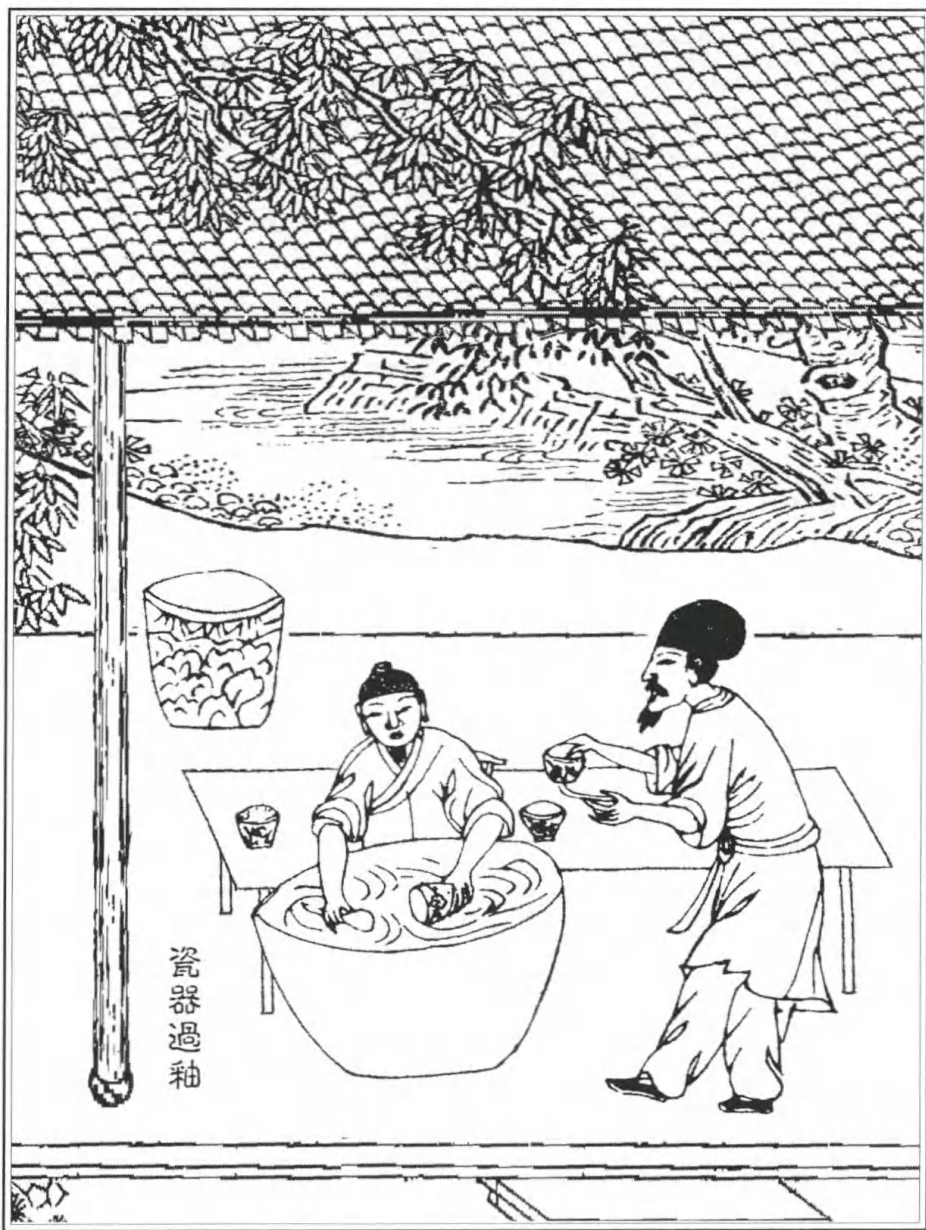
瓷坯過利

Polishing clayware with potter's wheel



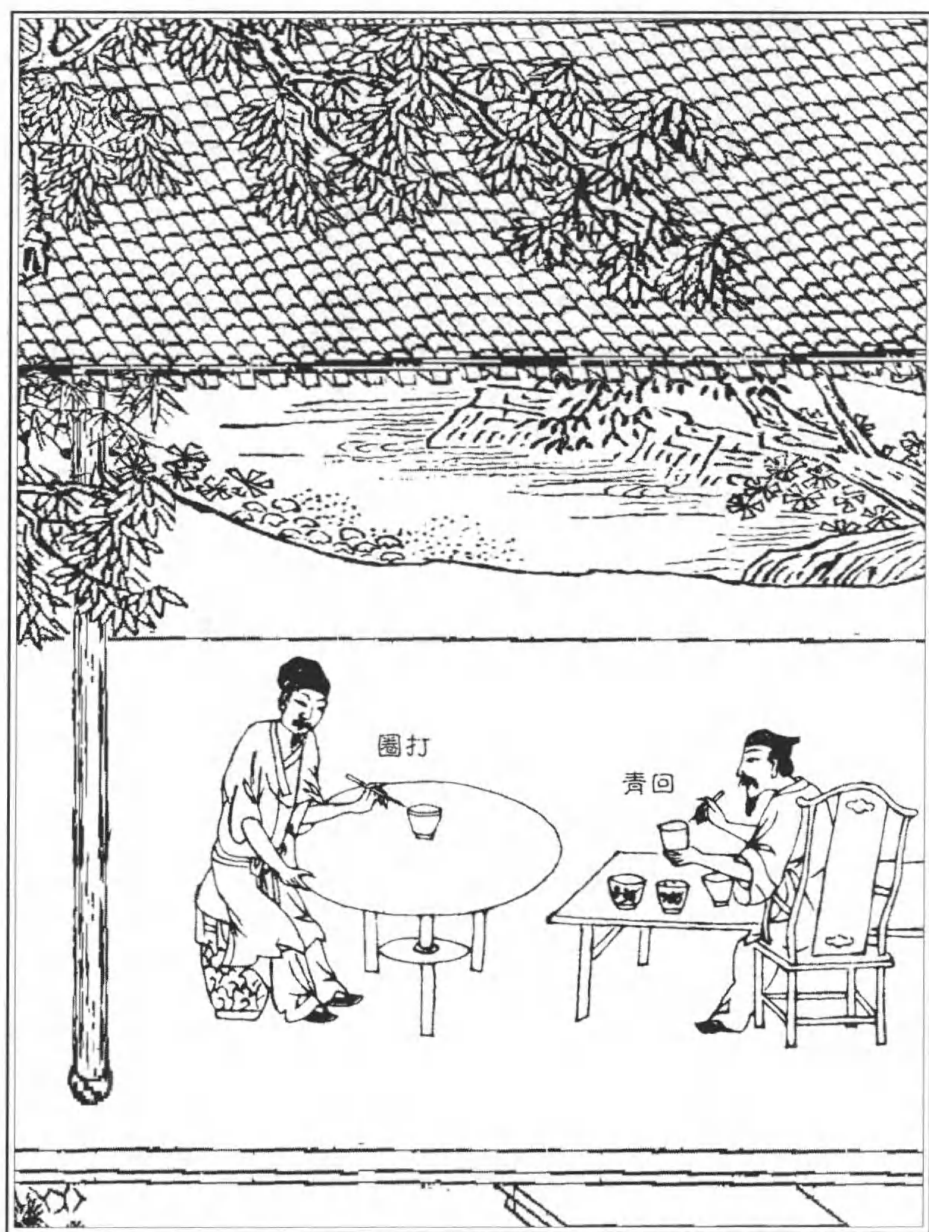
瓷坯汶水

Dipping thoroughly dried wares in water



瓷器過釉

Dipping clayware in liquid glaze



瓷坯画彩

Decorating porcelain ware



瓷窑
Porcelain kiln



【原文】

御器则有瓷屏风、烛台之类。先以黄泥塑成模印，或两破或两截，亦或囫圇，然后埏白泥印成，以釉水涂合其缝，烧出时自圆成无隙。一曰圆器，凡大小亿万杯、盘之类，乃生人日用必需。造者居十九，而印器则十一。造此器坯，先制陶车。车竖直木一根，埋三尺入土内，使之安稳。上高二尺许，上下列圆盘，盘沿以短竹棍拨运旋转，盘顶正中用檀木刻成盔头帽其上。

凡造杯、盘，无有定形模式，以两手捧泥盔帽之上，旋盘使转。拇指剪去甲，按定泥底，就大指薄旋而上，即成一杯碗之形（初学者任从作废，破坯取泥再造）。功多业熟，即千万如出一范。凡盔帽上造小

【今译】

右两半、或上下两截，或者是整体模型。然后将瓷土揉成的白泥放入模内印成泥坯，用釉水将接缝涂合，烧出时自然完好无缝。另一种叫圆器，这类包括无数大小不等的杯、盘之类，均为日用必需。造圆器的占十分之九，而印器则占十分之一。制造圆器的坯也要陶车。陶车上竖直木一根，三尺埋入地下，使其固定。地上高出二尺左右，上下各装圆盘，盘沿用短竹棍拨动旋转，顶盘正中放一盔头帽，以檀木做成。

造杯、盘时，没有固定模型，用两手将泥捧在陶车的盔帽上，旋转圆盘，用剪过指甲的拇指按定泥的底部，用大指轻轻使圆盘向上旋转，即做成杯、碗的坯形（初学者捏坏便作废，坏了就取泥再做一个）。功夫久业务熟练的，即使造出千万个杯、碗，也如出一模。在盔帽上造小件坯时，不必加泥。造中等盘、大碗则增加泥使盔帽扩大，干燥后



There are two kinds of porcelain bodies. The first is called "pressed ware" which consists of utensils like vases, jugs, incense burners, boxes and the like. They have different shapes, imperial articles like porcelain screens, candlesticks, and the like are also included. To make the "pressed ware", first, fashion yellow clay molds, whether in whole or in two halves cut vertically or across, then cast white clay paste into the mold, the seams are painted with a liquid glaze, and the resulting product will be an entire unbroken piece after firing. The other kind of porcelain body is called "round ware". This includes various kinds of cups and dishes which are all daily necessities. They take up ninety percent of all the porcelain made, while "pressed ware" takes up ten percent. To make "round ware", a potter's wheel must be set up first. The wheel revolves around a wooden axle which has been planted in the earth to three *chi* deep to insure its stability, with the exposed part about two *chi* high. The vertical axle is mounted with two horizontal discs, one on the top and one at the bottom, which are turned from the rims by using short bamboo sticks. A mandrel made of sandalwood protrudes from the centre of the upper disc.

There are no fixed molds for making cups and dishes. Place the clay paste over the mandrel that is made to revolve by turning the discs. The worker then presses his first finger with the nail clipped off, over the bottom of the clay, while the thumb lightly shapes the clay body as it revolves. Thus a cup or a bowl will be made. (Beginners are allowed to discard their spoiled cups and to make new cups with clay.) Porcelain made by experienced skillful makers is almost the same, even if they make a thousand cups or bowls, as though they had come out of the same mold. If small cups are to be made, the mandrel is used as it is.



【原文】

坯者，不必加泥，造中盘、大碗则增泥大其帽，使干燥而后受功。凡手指旋成坯后，覆转用盃帽一印，微晒留滋润，又一印，晒成极白干。入水一汶，漉上盃帽，过利刀二次（过刀时手脉微振，烧出即成雀口）。然后补整碎缺，就车上旋转打圈。圈后，或画或书字，画后喷水数口，然后过釉。

凡为碎器与千钟粟与褐色杯等，不用青料。欲为碎器，利刀过后，日晒极热，入清水一蘸而起，烧出自成裂纹。千钟粟则釉浆捷点，褐色杯则老茶叶煎水一抹也。（古碎器，日本国极珍贵，真者不惜千金。古香炉碎器不知何代造，底有铁钉，其钉掩光色不锈。）

凡饶镇白瓷釉，用小港嘴泥浆和桃竹叶灰调成，似清泔汁（泉州

【今译】

再处理。用手指旋泥成坯后，翻转过来，在盃帽上压印一下，稍晒至还有一点水分时，再压印一次，晒成极干并呈白色。入水中沾一下。滤水稍干后放在盃帽上，用利刀刮两次（手持刀时，如稍微颤动，烧成后即成缺口）。然后补齐破损的地方，放在陶车上旋转。随即在坯上写字、绘画，喷上几口水，再行过釉。

制作“碎瓷”、“千钟粟”与“褐色杯”等，都不用青釉料。欲制碎器，用利刀修整坯体，日晒到极热时入清水中一蘸即提起，〔涂上釉料〕烧后自成裂纹。千钟粟是用釉水迅速在坯上点，褐色杯则用老茶叶煎水抹在坯上。（古代制造的碎器在日本国极受珍重，真品不惜用千金购买。古代的香炉碎瓷不知何代所造，其炉底有铁钉，此钉光亮而不生锈。）

景德镇白瓷的釉是用小港嘴的泥浆及桃竹叶灰调成的，像澄清的淘米水（泉州府的瓷器仙人，是用松毛灰和瓷泥调成泥浆来上釉的，处州府的



If medium-sized dishes or large bowls are made, the mandrel is first enlarged with clay and used after it is dried. It is not necessary to add clay into the mandrel when making unburnt bricks for small utensils. Add clay to enlarge the mandrel when making medium and big bowls and wait until they are dry. Follow the same method to make medium and big bowls. Turn them around and press for a short while on the mandrel, then dry them in the sun until there is a little moisture left, press on the mandrel again and dry them completely when they are white. After that, dip them in water and take them out quickly. Put them on the mandrel when they are a little dry, scrape the surface with a sharp knife twice. (If the worker holding a knife tremors a little, the final products will be damaged after they are fired.) Put patch on gaps and turn on the wheel. Write some words or draw pictures on them immediately, then spray some water and glaze them.

No blue coloring material is used for the glazing and painting of “crackled ware”, “Qianzhongsu”, or “brown cups”. To make a crackled ware, the clay body is exposed directly to the sun after polishing with the knife until it is very hot and then is dipped once quickly in clear water, the resulting product will show crackled marks after firing. The “Qianzhongsu” ware is fashioned by very swift dotting of the surface with a liquid glaze, while the “brown cups” are prepared by brushing the clay surface with the boiled old tea-leave juice. (In Japan the crackled ware produced in the ancient times is extremely valuable. And the Japanese like to pay a thousand taels of silver to buy a genuine one. There is an ancient crackled-ware incense burner, nobody knows when it was made, and on its bottom an iron nail is embedded which is still bright and not rusted.)

In Jingdezhen the liquid glaze used for coating white porcelain ware is a mixture of water, the clay from Xiaogangzui, and the ashes of



【原文】

瓷仙用松毛水调泥浆，处郡青瓷釉未详所出）盛于缸内。凡诸器过釉，先荡其内，外边用指一蘸涂弦，自然流遍。凡画碗青料总一味无名异（漆匠煎油，亦用以收火色）。此物不生深土，浮生地面。深者掘下三尺即止，各直省皆有之。亦辨认上料、中料、下料，用时先将炭火丛红煨过。上者出火成翠毛色，中者微青，下者近土褐。上者每斤煨出只得七两，中、下者以次缩减。如上品细料器及御器龙凤等，皆以上料画成。故其价每石值银二十四两，中者半之，下者则十之三而已。

凡饶镇所用，以衢、信两郡山中者为上料，名曰浙料。上高诸邑者为中，丰城诸处者为下也。凡使料煨过之后，以乳钵极研（其钵底留粗，不转釉），然后调画水，调研时色如皂，入火则成青碧色。凡将

【今译】

青瓷釉，不知用什么做材料）盛入缸内。各种坯体上釉时，先将釉水在坯体内摇荡以挂釉，外面用手指蘸釉涂边，釉水自然从边流遍全体。画碗的青色釉料只用无名异一种（漆匠煎桐油，也用无名异作着色剂）。此物不藏于深土，而是浮生于地面，最多不过三尺深，各省都有。但要辨认上料、中料和下料。使用时，先将无名异用炭火煨烧。上料出火后成青绿色，中料微青，下料接近土褐色。每煨烧一斤无名异，上料只得七两，中、下料依次减少。制上品细料器及御用龙凤缸等，都用上料画成，故其价每石值银二十四两，中者半之，下者则值十分之三。

饶州府景德镇所用的釉料，以浙江衢州、江西广信两地山中所产的为上料，名曰浙料。江西上高等县所产的为中料，而江西丰城等处所产的为下料。将釉料煨烧后，用乳钵研得极细（乳钵底部要粗涩，不上釉），然后调画水，使研调时其色呈黑色，入火烧后成蓝色。欲制



the leaves from peach trees and bamboo, which looks like a clear rice broth. (The porcelain figurines made in Quanzhou are glazed with a mixture of ashes of pine leaves, water and clay, while nobody knows what materials are used to glaze the dark-blue colored porcelain in Chuzhou Prefecture.) The liquid glaze is placed in a large water jar. To glaze various types of wares, first put the liquid glaze into the inside of the wares, and shake them so that the interior of the wares can be glazed. Then smear, with fingers, a certain amount of the glaze to the rim of each ware, and the glaze will come down itself and spread the entire surface. Blue glaze used for glazing bowls is made from pyrolusite. (Lacquerers/painters also use it as a colorant material when they heat tung oil.) This material can be obtained everywhere, in every province, near the earth's surface, but not deep in the ground; and the deepest is about three *chi*. However, it needs identifying as it can be divided into three grades, i.e. best, medium, and low grades. Before being used, it is calcined with charcoal fire first. The best grade material will turn dark green; the medium becomes light green while the low grade material turns brown. One *jin* of the best grade of the material can produce seven *liang* of pyrolusite, while the medium and low grade of the material can produce less amount of pyrolusite. The decorating of the finest pieces of utensils and dragon and phoenix jars need the best grade of glaze, so the price for such a best grade of pyrolusite is twenty-four *liang* of silver per *dan*. While the medium grade costs half of that price and low grade costs one third of that price.

Of all the glazing materials used in Jingdezhen of the Raozhou Prefecture, those produced in the mountains of Quzhou in Zhejiang Province and Guangxin in Jiangxi Province are the best and are called *zhe* materials. The ones produced in Shanggao and other counties of Jiangxi Province are the medium grade, and the one produced in



【原文】

碎器为紫霞色杯者，用胭脂打湿，将铁线纽一兜络，盛碎器其中，炭火炙热，然后以湿胭脂一抹即成。凡宣红器乃烧成之后出火，另施工巧微炙而成者，非世上朱砂能留红质于火内也。（宣红元末已失传，正德中历试复造出。）

凡瓷器经画过釉之后，装入匣钵（装时手拿微重，后日烧出即成坳口，不复周正）。钵以粗泥造，其中一泥饼托一器，底空处以沙实之。大器一匣装一个，小器十余共一匣钵。钵佳者装烧十余度，劣者一二次即坏。凡匣钵装器入窑，然后举火。其窑上空十二圆眼，名曰天窗。火以十二时辰为足。先发门火十个时，火力从下攻上。然后天窗掷柴烧两时，火力从上透下。器在火中，其软如绵絮。以铁叉取一以验火候之足。辨认真足，然后绝薪止火，共计一杯工力，过手七十二

【今译】

成紫霞色的碎器杯，则将胭脂粉打湿，用铁线编成网兜，把碎器放在其中，以炭火煨烧，然后用湿胭脂一抹即成。“宣红”瓷器，是烧成后另外以巧妙的技术用微火烧成的，并非世上有哪种朱砂经火烧后还能保留红色的。（宣红在元末已失传，正德年间经多次试验才又造出来。）

瓷器坯经过画彩、过釉之后，装入匣钵之中（装时手持坯器如稍一用力，后来烧出后即成凹口，不再复原）。匣钵以粗泥制成，其中每一泥饼托住一件瓷器，底部空处以沙填实。大器一匣只装一个，小器十多个共装入一个匣钵之中。匣钵佳者可装烧十多次，劣者一两次即坏。匣钵装器入窑，然后点火。窑上留十二个圆孔，名曰天窗。烧火十二个时辰足够。先从窑门点火，烧十个时辰，火力从下攻上。然后从天窗投入薪柴再烧两个时辰，火力从上透下。瓷器在火中像棉絮那样软，用铁叉取出一件，检验火候是否已足。辨认火候足时，然后停薪止



Fengcheng in Jiangxi Province is the low grade. After being calcined, the glaze material is ground into fine powders in a mortar (The mortar should be rough at the bottom and not glazed) and then is mixed with water. Make the glaze black when grinding it and blue when burning it in a fire. To make a “purple-cloud” color crackled cup, first wet the ware with an aqueous solution of rouge, and then place it in a wire net for convenience in heating over a charcoal fire. After that, brush the ware once with a pad of cotton wetted with rouge, and the coloring effect is obtained. This kind of colored porcelain is called “*Xuan* red” ware made by the very skillful coloring in conjunction with the slight roasting of a special kind of pre-fired ware. No cinnabar in the world can remain red after being fired. (“*Xuan* red” is lost at the end of the Yuan Dynasty and is rediscovered when Emperor Zhengde was in power after many tests and trials).

After the porcelain wares are colored and glazed, they are put, gently in hand, into box frames gently with hand (a slightly heavy push of the porcelain wares will damage them and they can not be recovered after being fired). The box frames are made of coarse clay. Every mud cake in it underprops an article of porcelain, and its hollow bottom is filled with sand. A saggar can only hold one big piece of porcelain but over ten small ones. Saggar of good quality can stand burning over ten times while low quality saggar will be destroyed after firing only once or twice. After the kiln is completely loaded with packed saggars, a fire is kindled. Toward the top of the kiln there are twelve round holes, called skylights. The firing should continue for twenty-four hours. The first twenty hours include firing from the kiln door so that the heat rises from the bottom upward, the lighted wood is thrown in through the skylights and burned for four more hours so that the heat travels from the top downward. When they are in the burning kiln the porcelain pieces are soft like



【原文】

方克成器，其中微细节目尚不能尽也。

附：窑变、回青

正德中，内使监造御器。时宣红失传不成，身家俱丧。一人跃入自焚，托梦他人造出，竟传窑变，好异者遂妄传烧出鹿、象诸异物也。又回青乃西域大青，美者亦名佛头青。上料无名异，出火似之，非大青能入洪炉存本色也。

【今译】

火。合计造一个杯所用之功力，要经过七十二道手续才能成器，其中很多细节还不能尽述。

附：窑变、回青

正德年间，宦官监造宫中御用瓷器。当时宣红瓷制法失传，造不出来。烧瓷的人有失身家性命之险，有一个人跳入窑内自焚，托梦给别人造出了宣红。从此人们竞相传播有窑变之法。好奇的于是妄传烧出鹿、象之类异物。另外，回青本是西域产的大青，优质的又名佛头青。用上等的无名异作釉料烧出的瓷，其颜色与大青相似，并非大青入窑烧后还能保持其本来颜色。



cotton wool. To test the degree of firing, one article can be taken out of the kiln with a pair of iron forks, and the fire is stopped if the specimen is heated enough. A portion of clay must pass through seventy-two procedures before it is made into a cup, excluding some minute details.

Supplements: Transmutation in Kilns, and Mohammedan Blue

When Emperor Zhengde was in power, eunuchs were in charge of the production of porcelain used in the palace. At that time, the process of making *Xuan* red porcelain was lost and *Xuan* red porcelain could not be produced. Potters ran the risk of losing their lives. One of the potters jumped into a burning kiln and killed himself. Later he appeared in another person's dream and disclosed the secret of the red color and that person could produce the *Xuan* red again. This piece of news was then spread widely and quickly and was known as transmutation in the kilns. Later some miracle-fanciers even said that the kiln produced strange objects such as deer, elephants, etc. What's more, mohammedan blue is the "deep blue" glaze material of the Western Regions, the best quality of which is also called "Buddha's head black". The-top grade pyrolusite, after firing, is similar to the "deep blue" in color. It is not true that the "deep black" can retain its original color after being exposed to the intense heat of the porcelain kilns.



燔石第十二

【原文】

宋子曰，五行之内，土为万物之母。子之贵者岂唯五金哉！金与火相守而流，功用谓莫尚焉矣。石得燔而成功，盖愈出而愈奇焉。水浸淫而败物，有隙必攻，所谓不遗丝发者。调和一物以为外拒，漂海则冲洋澜，粘瓮则固城雉。不烦历候远涉，而至宝得焉。燔石之功，殆莫与之京矣。至于矾现五色之形，硫为群石之将，皆变化于烈火。巧极丹铅炉火。方士纵焦劳唇舌，何尝肖像天工之万一哉！

石 灰

凡石灰经火焚炼为用。成质之后，入水永劫不坏。亿万舟楫，亿万垣墙，室缝防淫是必由之。百里内外，土中必生可燔石。石以青

【今译】

宋子说，五行之内，土为万物之本。从土所产生的贵重物品中，岂止是金属一种！金属与火相互作用而熔化并制成器物，其功用可谓无可比拟。然而非金属矿石经焚烧后也同样如此，也可说是愈演愈奇妙。水渗透到物体内有破坏作用，而且有缝必钻，可以说丝发之缝都不放过。但造船时用石灰调料填缝，便能防止渗水，使船舶劈波斩浪，漂洋过海。以石灰砌砖，可使城池坚固。这种材料，无需长期远涉便可得到。所以，烧石的功用恐怕是再大不过的了。至于烧矾矿石能得到五种颜色的不同形态，并使硫黄成为群石之将，这都是在烈火中变化出来的。这种技巧在炼炉内制取丹砂与铅粉时，已发挥得淋漓尽致。不过炼丹术士纵然费尽唇舌去吹嘘，他们的本事怎能及自然力之万一呢！

石 灰

石灰是经火烧炼石灰石制成的。石灰凝固以后，遇水永远不会被破坏。众多的船只和墙壁，填缝防水必须要用石灰。百里内外的土中



Chapter 12

Calcination of Stones

Songzi says that among the five elements, gold, wood, water, fire and earth, earth is the origin of all the living things on earth. Valuables obtained from earth are more than just metals. When metals and fire interact with each other and the metals melt, thus utensils can be made. Its use cannot be compared and surpassed. However, calcining non-metal ores can also have the same function. If water penetrates the hull of a ship, it will harm the ship. To make matters worse, water can enter any tiny crack, even as tiny as a hair. However, filling the cracks with lime can prevent water from coming in. The ship can battle waves and travel overseas. Walls built by bricks which are made from lime are very strong. The material can be got easily nearby. Therefore, calcining stones are very useful. Furthermore, the alum of five colors and the masterly qualities of sulphur result from the application of intense heat. Such skills climax in the distilling of litharge. However, even though alchemists boast laboriously, how can their ability match even one-thousandth of the power of nature?

Lime

Lime is made by calcining limestone. When lime becomes solid, it can not ever be damaged by water. Gaps in a large number of ships and walls must be filled with lime to prevent water from entering. There must be limestone within an area of a hundred *li*, black-colored stones being the best, yellow stones and white stones the second.



烧石成灰

Burning coal cakes to make oyster ash



鑿取蛎房

Removing oyster shells from rocks with mallet and chisel



【原文】

色为上，黄白次之。石必掩土内二三尺，掘取受燔，土面见风者不用。燔灰火料，煤炭居十九，薪炭居十一。先取煤炭、泥，和做成饼。每煤饼一层，垒石一层，铺薪其底，灼火燔之。最佳者曰矿灰，最恶者曰窑滓灰。火力到后，烧酥石性，置于风中，久自吹化成粉。急用者以水沃之，亦自解散。

凡灰用以固舟缝，则桐油、鱼油调，厚绢、细罗和油杵千下塞舱。用以砌墙、石，则筛去石块，水调黏合。甃埽则仍用油灰。用以垩墙壁，则澄过，入纸筋涂埽。用以裹墓及贮水池，则灰一分入河沙、黄土三分，用糯米糨、杨桃藤汁和匀，轻筑坚固，永不隳坏，名曰三和土。其余造靛、造纸，功用难以枚述。凡温、台、闽、广海滨，石不堪灰者，则天生蛎蚝以代之。

【今译】

总会有可烧成石灰之石，这种石以青色的为上料，黄、白色的次之。石灰石埋于地下二三尺内，掘取出来烧炼，但表面风化的不能采用。烧石灰的燃料中，煤炭占十分之九，薪炭占十分之一。先将煤炭用泥合成饼，每一层煤饼上堆一层石，下面铺以燃料，点火烧之。最好的叫矿灰，最差叫窑滓灰。火力一到，便将石烧脆，放在风中，时间一久便成为粉。急用时以水沃湿，也会自成粉末。

用石灰填固船缝时，得与桐油或鱼油调配，放在厚绢或细罗上用油拌和，再杵一千下以后塞缝。用石灰砌墙或砌石时，要筛去其中的石块，用水调黏。涂饰器物，仍用油灰。用石灰粉刷墙壁，则将石灰用水澄清，加入纸筋后再涂抹。用来修坟墓或蓄水池时，则是石灰一份，加入河沙、黄土三份，以糯米糊、杨桃藤汁和匀，轻轻一压便很坚固，永不毁坏，名曰三和土。其余如制造蓝靛、造纸，都离不开石灰，其用途难以枚述。浙江温州、台州以及福建、广东沿海地区的石头如不能烧成石灰，则有天然产生的牡蛎壳可作代用品。



Limestone is usually buried two or three *chi* underground. Dig it out and calcine it. But limestone weathered on the surface cannot be used. Fuel used to calcine limestone is mostly coal, which takes up ninety percent, while firewood takes up ten percent. First, mix coal with mud to form cakes, put a layer of stones between each two layers of cakes, put fuel at the bottom to light and fire it. The best one is called "mine lime" and the lowest grade is called "kiln dross". A fire is lighted, and the stones are burned into pieces, place these pieces in a windy place, and they will become powder over time. If it is needed urgently, water them and they will become powder.

To fill the gaps in ships, the lime has to be mixed with tung oil or fish oil. Place them on thick silk pongee or thin silk gauze and mix with oil, strike with a pestle a thousand times. Then it is ready to fill the gaps. When building walls with lime, screen stones out and mix with water to make it sticky. When painting utensils, use putty. If polishing walls with lime powder, clarify lime with water. Then it is ready for use after paper fibre is added. When mending tombs and reservoirs, add one share of lime and two shares of fluvial sand and loess, mix with sticky rice paste and carambola vine water equally, press the mixture gently and it will be strong enough to last forever. This is called tri-mixture mud. Lime is also indispensable in making crude indigo and paper, so it is widely used. Some stones in Wenzhou and Taizhou in Zhejiang Province and coastal areas of Fujian and Guangdong provinces can not be used to make lime, but the oyster shells that forms naturally can be used as a substitute.



【原文】

蛎 灰

凡海滨石山傍水处，咸浪积压，生出蛎房，闽中曰蚝房。经年久者长成数丈，阔则数亩，崎岖如石假山形象。蛤之类压入岩中，久则消化作肉团，名曰蛎黄，味极珍美。凡燔蛎灰者，执锥与凿，濡足取来（药铺所货牡蛎，即此碎块），垒煤架火燔成，与前石灰共法。粘砌城墙、桥梁，调和桐油造舟，功皆相同。有误以蚬灰为蛎灰者，不格物之故也。

煤 炭

凡煤炭普天皆生，以供煅炼金石之用。南方秃山无草木者，下即有煤，北方勿论。煤有三种，有明煤、碎煤、末煤。明煤块大如斗许，燕、齐、秦、晋生之。不用风箱鼓扇，以木炭少许引燃，熇炽达昼夜。其旁夹带碎屑，则用洁净黄土调水作饼而烧之。碎煤有

【今译】

蛎 灰

在海滨靠水的石山之处，由于海浪的长期冲压，生出一种蛎房，福建称为蚝房。年深日久蛎房长到数丈之长，宽达数亩，崎岖不平，形状像是假石山。蛤蜊之类被冲压到石岩中，时间久了则化成肉团，名曰蛎黄，其味极其珍美。烧蛎灰的人手执锥与凿，涉水将蛎房取来（药铺所卖的牡蛎，就是其碎块），堆起煤将蛎壳架火焚烧，与前述烧石灰的方法一样。用蛎灰粘砌成墙、桥梁，或与桐油调和造船，功用与石灰都是一样的。有人误以为蚬灰就是牡蛎灰，是因为没有推追事物之原理所造成的。

煤 炭

煤炭在中国到处都出产，供作烧炼金、石之用。南方不长草木的秃山下面就有煤，北方也是如此。煤有三种，分为明煤、碎煤、末煤。明煤块大如斗，河北、山东、陕西、山西出产。明煤无需风箱鼓风，以木炭少许引燃，可昼夜猛烈燃烧。其中夹带的碎屑，可用洁净



Oyster Ash

On the rocky hills near the seashore, as a result of the perennial lapping and pressing of waves, oyster houses form. As time goes on, oyster houses will grow several *zhang* in length and several acres in width. They are rugged and look like fake rocky hills. Clams and the like are pushed onto the rocks and slowly become meatballs and are very delicious. People who burn oyster ash hold a mallet and a chisel in each hand and wade through the water to get to an oyster house. (Oysters sold in drugstores are pieces of oyster houses.) Pile coal and burn oyster shells using the same method as calcining lime. Build walls and bridges using oyster ash or make ships by mixing it with tung oil. It has the same function as lime. Some people mistake clam ash for oyster ash, because they don't know how they are formed.

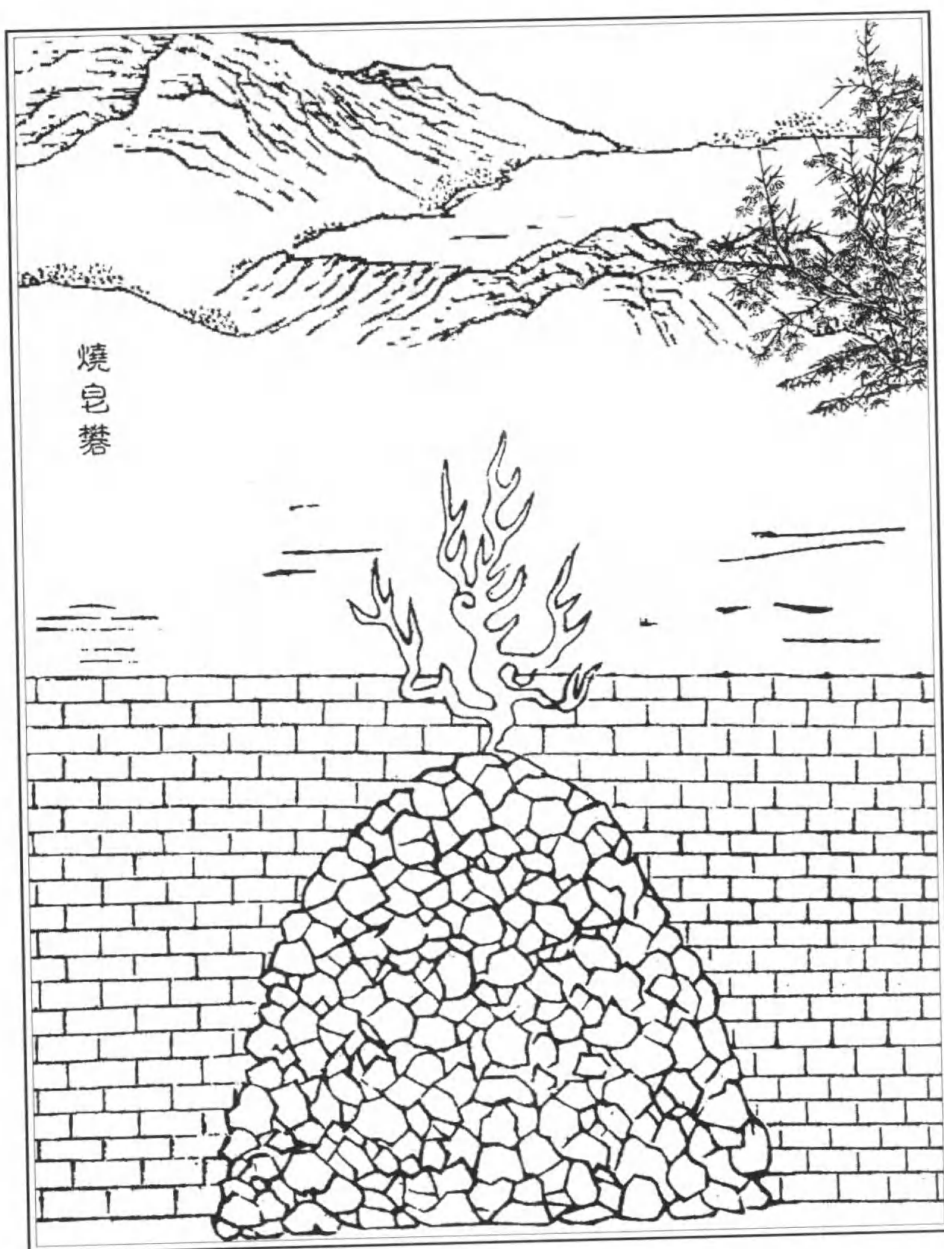
Coal

For the purpose of melting and calcinating gold and stone, coal which is obtainable everywhere in China is used. There is coal beneath mountains without grass and trees on them in the South and in the North. There are three kinds of coal, that is, bright coal, conny, and slack coal. Blocks of bright coal are as big as *dou* which are produced in Hebei, Shandong, Shaanxi and Shanxi provinces. It is not necessary to blast them with bellows. Light them up with a little firewood and they will keep burning fiercely for a whole day without dying out. Fragments of the coal can be mixed with clay water and clean loess to make cakes for fuel. There are two kinds of conny which are mostly produced in Wu and the locality of Chu. Of the two kinds, the one with a high flame is called food coal used in cooking. The other one with a



南方挖煤

Coal mining in South China



燒皂礬

Burning copper coal for black vitrio



【原文】

两种，多生吴、楚。炎高者曰饭炭，用以炊烹。炎平者曰铁炭，用以冶煅。入炉先用水沃湿，必用鼓鞴后红，以次增添而用。末煤如面者，名曰自来风。泥水调成饼，入于炉内。既灼之后，与明煤相同，经昼夜不灭。半供炊爨，半供熔铜、化石、升朱。至于燔石为灰与矾、硫，则三煤皆可用也。

凡取煤经历久者，从土面能辨有无之色，然后掘挖。深至五丈许，方始得煤。初见煤端时，毒气灼人。有将巨竹凿去中节，尖锐其末，插入炭中，其毒烟从竹中透上。人从其下施钁拾取者。或一井而下，炭纵横广有，则随其左右阔取。其上支板，以防压崩耳。

凡煤炭取空而后，以土填实其井。经二三十年后，其下煤复生长，取之不尽。其底及四周石卵，土人名曰铜炭者，取出烧皂矾与硫黄。凡石卵单取硫黄者，其气薰甚，名曰臭煤。燕京房山、固安，湖

【今译】

的黄土调水做成煤饼来燃烧。碎煤有两种，多产于吴、楚。其中火焰高的叫饭炭，用来做饭。火焰低的叫铁炭，用以冶炼。这种煤入炉前要先用水沃湿，必须用风箱鼓风才能烧红，以后逐次添煤保持燃烧。末煤是像面粉那样的粉末，名叫“自来风”。将其与泥、水调成饼放入炉内。燃烧以后与明煤相同，昼夜不灭。末煤有一半供作烧饭，一半供熔铜、烧石、炼取朱砂。至于烧炼石灰、矾和硫，则三种煤都可以使用。

长期采煤的人，能从土的表面辨别地下是否有煤，然后挖掘。挖到五丈深左右，方始得煤。初见煤层露头时，地下冒出的毒气能灼伤人。因此有人将巨竹筒凿去中节，将竹筒末端削尖，插入煤炭中，毒气便沿竹筒向上排出，人便可在下面用大锄挖取煤。当井下有煤层向纵横延伸时，可沿煤层向左右挖取。其上部以木板支护，以防压塌。

煤炭取空而后，用土将井填实。经二三十年后，井下面又生长出煤，取之不尽。其底及四周有卵石，当地人叫铜炭，取出后可以烧制皂矾与硫黄。只能烧制硫黄的卵石，臭气十分难闻，名曰臭煤。京师的房山、固安及湖广荆州等处间有这种煤。煤炭燃烧以后，其质随火化去，不留灰渣。因为在金属与土石之间，自然界的变化的有不同的表



low flame is called iron coal, and is used in smelting and forging metals. This kind of coal has to be wet before being put in furnaces and must be blasted with bellows so that it can be heated to red. Keep adding coal to keep it burning. Slack coal is powder, just like flour, and is called “automatic wind”. Mix it with mud and water, make it into cakes to put in the stove for burning. When it burns, it doesn’t stop burning, which is the same as bright coal. Half of the slack coal is used to cook and half is used to smelt copper, calcine stones and melt vermilion. As for smelting lime, alum and sulphur, all of the three kinds of coal can be used.

People who have excavated coal for a long time can tell from the surface of the ground if there is coal underground. Dig five *zhang* deep, and you can get coal. As soon as the coal is exposed, it will burst out with a poisonous gas which is dangerous to people. Therefore, some people hollow out a large bamboo and sharpen one end to plug into the coal, the poisonous gas will come out through the bamboo. Then, people can excavate the coal safely with a big hoe. If the vein of coal extends vertically and horizontally, people can excavate along the vein, with timber built overhead in the mine to prevent collapse.

After the coal has been exhausted, fill the coal mine with earth. People once thought it would grow out coal again after twenty or thirty years. This is not reasonable. At the bottom and around the mine, there are pebbles which are called copper charcoal. They can be used to burn black vitriol and sulphur. These pebbles are stinky and are called stinky coal. Places like Fangshan and Gu’an near Beijing and Jingzhou of Huguang and so on have this kind of coal. There is nothing left after it is burned. This means that it is a special manifestation of Nature placed between the species of metal and that of earth and stone.



【原文】

广荆州等处间有之。凡煤炭经焚而后，质随火神化去，总无灰滓。盖金与土石之间，造化别现此种云。凡煤炭不生茂草盛木之乡，以见天心之妙。其炊爨功用所不及者，唯结腐一种而已（结豆腐者，用煤炉则焦苦）。

矾石、白矾

凡矾燔石而成。白矾一种亦所在有之，最盛者山西晋、南直无为等州。价值低廉，与寒水石相仿。然煎水极沸，投矾化之，以之染物，则固结肤膜之间，外水永不入。故制糖饴与染画纸、红纸者需之。其末干撒，又能治浸淫恶水，故湿创家亦急需之也。

凡白矾，掘土取磊块石，层垒煤炭饼煅炼，如烧石灰样。火候已足，冷定入水。煎水极沸时，盘中有溅溢，如物飞出，俗名蝴蝶矾者，则矾成矣。煎浓之后，入水缸内澄。其上隆结曰吊矾，洁白异常。其沉下者曰缸矾，轻虚如绵絮者曰柳絮矾。烧汁至尽，白如雪者谓之巴石。方药家煅过用者曰枯矾云。

【今译】

现形式。煤炭不产于草木茂盛的地方，从这里可见到大自然的巧妙安排。在炊事方面，煤炭唯一不能发挥作用的，只是不能用来做豆腐而已（在煤火上点豆腐则味苦）。

矾石、白矾

矾类借烧石而得。有一种白矾（明矾）到处都有，出产最多的是山西晋州、南直隶无为州等处。价值低廉，与寒水石很相似。然而当水煮沸时，将明矾投入沸水中溶化，用以染物则其色固着在表面，不怕水浸。因此制糖果、蜜饯以及染绘画纸、红纸时需要明矾。将干的明矾粉末撒在外伤患处，能治疗流出臭水的湿疹、疮疮，因此也是湿疹患者急需的药品。

制取白矾时，掘土取出矾石石块，与煤饼逐层堆积起来烧炼，就像烧石灰那样。烧足火候，任其彻底冷却，加入水中。将水溶液煮沸，锅内出现飞溅出来的东西，俗名叫“蝴蝶矾”，至此明矾便制成了。再将其煎浓之后，倒入水缸内澄清。上面凝结的叫吊矾，洁白异常。沉在缸底下的叫缸矾，轻虚如棉絮的叫柳絮矾。锅内容液烧尽后，锅底剩下的是白如雪的巴石。经炼丹家、本草学家烧炼过做药用的，叫枯矾。



It is a clever arrangement by Nature that coal is not produced in places where grass and wood abound. In cooking, the only drawback of coal is that it cannot be used to make bean curds (bean curds made with coal are bitter).

Alum Stone and Alum

Alum is made by calcining stones. Alum can be found everywhere, and Jinzhou of Shanxi Province and Wuweizhou of Nanzhili have the most. It is very cheap, and similar to gypsum. When the water is boiling, put the alum in, and the alum will dissolve in the water. When dyeing things with the solution, the color will cling to the surface, and the things will be waterproof. So alum is indispensable when making candy and confection and dyeing drawing paper and red paper. When made into dry powder, alum is effective in removing impurities and watery infections, and is therefore much needed by eczema sufferers.

When making alum, dig deep to get alum stone. Pile coal cakes and stones one after another and heat them. When they are heated enough, cool them completely and put them into water. Heat and boil the solution; what splashes out of the boiler is white alum with a popular name, butterfly alum. Roast the solution until it is dense; pour it into a water cylinder to settle it. The pretty white coagulation on the surface is called hanging alum, the sediment is called vat alum, and the one as light as cotton is called catkin. When the solution in the boiler is evaporated, the leftover sediment at the bottom is Bashi (Sichuan stone) which is as white as snow. Alum that has been used by alchemists and herbalists to make drugs is called dry alum.



【原文】

青矾、红矾、黄矾、胆矾

凡皂、红、黄矾，皆出一种而成，变化其质。取煤炭外矿石（俗名铜炭子），每五百斤入炉，炉内用煤炭饼（自来风，不用鼓鞴者）千余斤，周围包裹此石。炉外砌筑土墙圈围，炉巅空一圆孔，如茶碗口大，透炎直上，孔旁以矾滓厚掩（此滓不知起自何世，欲作新炉者，非旧滓掩盖则不成）。然后从底发火，此火度经十日方熄。其孔眼时有金光直上（取硫，详后款）。

煅经十日后，冷定取出。半酥杂碎者另拣出，名曰时矾，为煎矾红用。其中精粹如矿灰形者，取入缸中浸三小时，漉入釜中煎炼。每水十石，煎至一石，火候方足。煎干之后，上结者皆佳好皂矾，下者为矾滓（后炉用此盖）。此皂矾染家必需用，中国煎者亦唯五六所。原石五百斤，成皂矾二百斤，〔此〕其大端也。其拣出时矾，每斤入黄土四两，入罐熬炼，则成矾红，圬墁及油漆家用之。

【今译】

青矾、红矾、黄矾、胆矾

皂矾、红矾、黄矾，都是由同一种物质变化而成的。挖取煤炭外层的卵石（俗名铜炭），每次将五百斤投入炉内，炉中用煤炭饼（也就是不需鼓风的、叫做自来风的这种煤饼）千余斤包裹住这些矿石。炉外砌筑土墙将炉围起，炉顶部留出茶碗口大的圆孔，使火焰直透其上，圆孔旁用烧矾的废渣厚压一层（用旧渣盖顶，不知始于何时。但要筑新炉，非用旧渣盖顶不成）。然后从炉底点火，预计要烧十天才熄火。燃火时从孔眼中不时有金色火焰冒出（像烧硫黄那样，详见下文）。

煅烧十天之后，冷却，取出皂矾。其中烧成半酥的杂碎者再另外拣出，名叫时矾，供煎炼红矾时用。其中的精华像矿灰形状的，取出放入缸中水浸三个时辰，再滤至锅中煎炼。将十石水溶液煎至一石，这时火候才算足。煎干之后，在上面凝结的都是最好的皂矾，下面的是矾渣（以后用这种渣盖炉顶）。皂矾是染房必须用的，中国只有五六个地方炼制皂矾。五百斤原矿石可烧制成二百斤皂矾，这是大致情况。拣出的时矾，每斤掺入黄土四两，在罐内熬炼，则制成红矾。泥水工和油漆工常使用红矾。



Black Vitriol, Red Vitriol, Yellow Vitriol and Gall Vitriol

Black vitriol, red vitriol, and yellow vitriol are all variations of the same material. Dig pebbles on the surface of coal tier (whose popular name is copper charcoal). Put five hundred *jin* of copper charcoal into a furnace each time, cover these pebbles with over a thousand *jin* of coal cakes (called "automatic wind" that needs no bellowing). Build a mud-brick wall outside surrounding the furnace, leaving a round hole about the size of the mouth of a bowl to let the flames out, cover the side of the hole with a thick vein of waste of burning alum. (It is not clear when this method began. And if it is a new furnace, covering the hole with waste is necessary.) Light up the furnace from the bottom and put it out until after ten days. There will be golden flames coming out of the hole from time to time, just like burning sulphur (for making sulphur, see below).

After ten days of burning, the calcinated products are taken out after they have completely cooled. The half-crumbling fragments, called "time vitriol", are selected and put aside for the making of red vitriol. The fine, lime-like powder is then put in water for six hours in a large jar, and then it is boiled in a pot. When the volume of every ten *dan* of solution, by boiling, is reduced to one *dan*, and to this stage heating is considered enough. After it is dried in the pot, the substance condensing on the surface is the best black vitriol. Usually two hundred *jin* of black vitriol can be produced from the burning of every five hundred *jin* of copper charcoal. The selected time vitriol (also called chicken-dropping vitriol) that has been put aside, is mixed with earth at a ratio of a *jin* of time vitriol with four *liang* of earth. And they are boiled in a pot; thus red vitriol can be obtained. Plasterers and varnish-painters use red vitriol frequently.



【原文】

其黄矾所出又奇甚。乃即炼皂矾炉侧土墙，春夏经受火石精气，至霜降、立冬之交，冷静之时，其墙上自然爆出此种，如淮北砖墙生焰硝样。刮取下来，名曰黄矾，染家用之。金色浅者涂炙，立成紫赤也。其黄矾自外国来，打破中有金丝者，名曰波斯矾，别是一种。

又山、陕烧取硫黄山上，其滓弃地二三年后，雨水浸淋，精液流入沟麓之中，自然结成皂矾。取而货用，不假煎炼。其中色佳者，人取以混石胆云。石胆一名胆矾者，亦出晋、隰等州，乃山石穴中自结成者，故绿色带宝光。烧铁器淬于胆矾水中，即成铜色也。本草载矾虽五种，并未分别原委。其昆仑矾状如黑泥，铁矾状如赤石脂者，皆西域产也。

硫 黄

凡硫黄乃烧石承液而结就。著书者误以焚石为矾石，遂有矾液

【今译】

黄矾的制造更是奇特，原料取自炼皂矾炉旁的墙土。土墙在春夏间烧炼皂矾时其成分受火的作用，到霜降、立冬之际天凉的时候，墙上自然出现这种矾类，就像在淮北砖墙上生出硝石那样。刮取下来，名曰黄矾，染房经常用到。用黄矾涂成浅金黄色的器物，在火上一烤便立即成为紫红色。从外国来的黄矾，打碎后里面有金丝的，叫波斯矾，这是另一个品种。

还有山西、陕西烧取硫黄的山上，其渣弃在地上二三年后，受雨水浸淋作用，其中的有效成分流入山沟，自然结成皂矾。取来后出售或使用，不需要煎炼。其中成色好的，有人拿来冒充石胆。石胆又名胆矾，亦出于晋州、隰州，是山石洞中自然结成的，因此呈绿色带有光泽。将烧热的铁器浸入胆矾水中，便生成铜。本草书上虽说记载了五种矾，但并没有辨明其原委。至于说到形状像黑泥的昆仑矾和形状像铁矾的赤石脂，这都是西北出产的。

硫 黄

硫黄是焚烧矿石时得到的液体凝结而成的，著书者误将焚石当



The making of yellow vitriol is more peculiar. The source material is the earth of the wall beside the furnace and is used to calcine black vitriol. As a result of fire, when people calcine red vitriol during spring and summer, yellow vitriol appears on the earth wall naturally from the Frost's Descent and the Beginning of Winter on, just like saltpeter on the brick wall in Huaibei. Scrape it down and it can be used in dyeing houses. Articles painted light golden with yellow vitriol will turn purple as soon as it is heated on fire. There is another kind of vitriol from abroad. Break it and there is spun gold in it, called "Persian vitriol".

In Shanxi and Shaanxi, on the mountains where sulphur is calcined, some effective components of the waste will flow into the mountain trench when it rains. They will form naturally black vitriol after two or three years. It can be sold and used directly without decoction. Some people think the good one is a counterfeit of the black vitriol. Black vitriol is also formed in Jinzhou and Xizhou in Shanxi Province. It is formed in stone caverns by itself, and as a result it is green with luster. Dip burning hot iron articles in black vitriol water, and they will become copper. Although there are five kinds of alum and vitriol recorded in the *Compendium of Materia Medica*, not all the details are included. Both "Kun-lun vitriol", shaped like black mud, and "red Kaolin," shaped like "iron vitriol", are produced in northwestern areas.

Sulphur

Sulphur is the coagulation of the liquid from calcining ore. Half of the ore used to calcine sulphur is from white stone in local areas, half is from stones which are used to calcine black vitriol in pebbles of the coal tier. Some people mistakenly say that there must be sulphur where



【原文】

之说。然烧取硫黄石，半出特生白石，半出煤矿烧矾石，此矾液之说所由混也。又言中国有温泉处必有硫黄，今东海、广南产硫黄处又无温泉，此因温泉水气似硫黄，故意度言之也。

凡烧硫黄石，与煤矿石同形。掘取其石，用煤炭饼包裹丛架，外筑土作炉。炭与石皆载千斤于内，炉上用烧硫旧滓掩盖，中顶隆起，透一圆孔其中。火力到时，孔内透出黄焰金光。先教陶家烧一钵盂，其盂当中隆起，边弦卷成鱼袋样，覆于孔上。石精感受火神，化出黄光飞走，遇盂掩住，不能上飞，则化成液汁靠着盂底，其液流入弦袋之中。其弦又透小眼，流入冷道灰槽小池，则凝结而成硫黄矣。

其炭煤矿石烧取皂矾者，当其黄光上走时，仍用此法掩盖，以取硫黄。得硫一斤，则减去皂矾三十余斤。其矾精华已结硫黄，则枯滓

【今译】

作矾石，因此产生一种说法，认为硫黄是烧矾石时流出的液体凝固而成的。然而烧取硫黄的矿石，一半来自当地特产的白石，一半来自煤层卵石中用以烧制皂矾的那种石头。这就是硫乃矾液之说所以造成混淆的原因。又有人说中国有温泉的地方必有硫黄，可是现在福建、广南产硫黄的地方又没有温泉。这是因为温泉水的气味似硫黄，由此揣度出这种说法。

焙烧硫黄的矿石与煤层的卵石有相同的形状。掘取其石，用煤饼包裹堆积起来，外面筑土作炉。用煤与矿石各一千斤装载在炉内。炉上用烧过硫黄的旧渣盖顶，中间隆起，其中开一圆孔。火力烧足时，孔内冒出金黄色的火焰和气体。事先由陶工烧制出一个钵盂，盂的中间隆起，周边卷成像鱼袋形状的凹槽，盖在圆孔上。石内的成分受到火的作用，化成黄色气体飞走，遇到盂被挡住而不能向上飞散，冷却后化成液体，贴着盂底而流入其周边的凹槽中。盂底边又开小眼，使液体流入冷管再进入石灰槽小池中，凝结以后便成为硫黄。

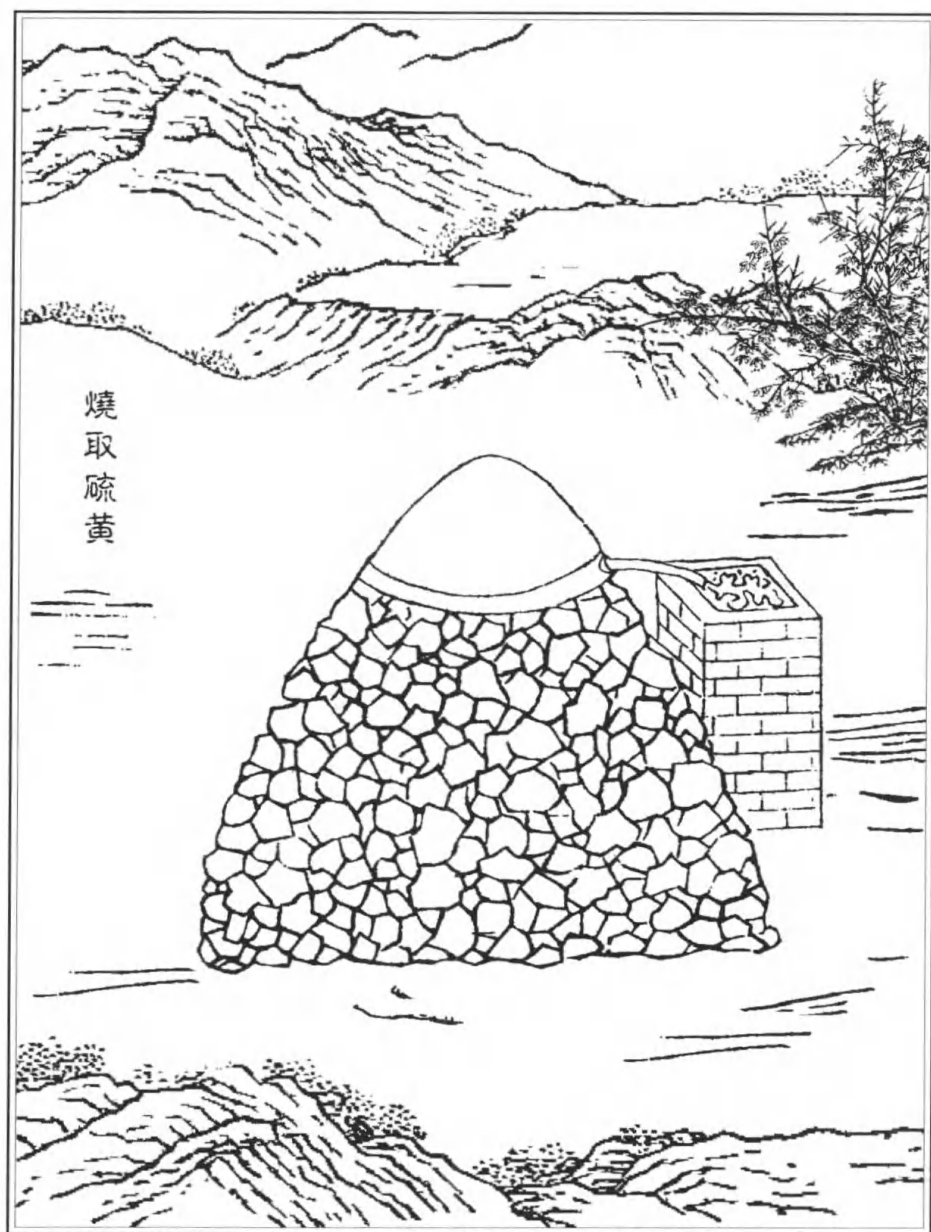
用煤层卵石烧取皂矾时，当黄色气体冒上来之际，仍用这种方法盖顶，以收取硫黄。每得一斤硫黄，便要少得三十余斤皂矾。当矾内成分转变成硫黄时，剩下的枯渣便成为废物。火药原料中，硫为纯阳，硝石为纯阴，硫与硝这两种成分一结合，便产生出音响和变化。



there are hot springs. However, there is sulphur in Fujian and Guangdong but no hot springs, because the spring water smells like sulphur.

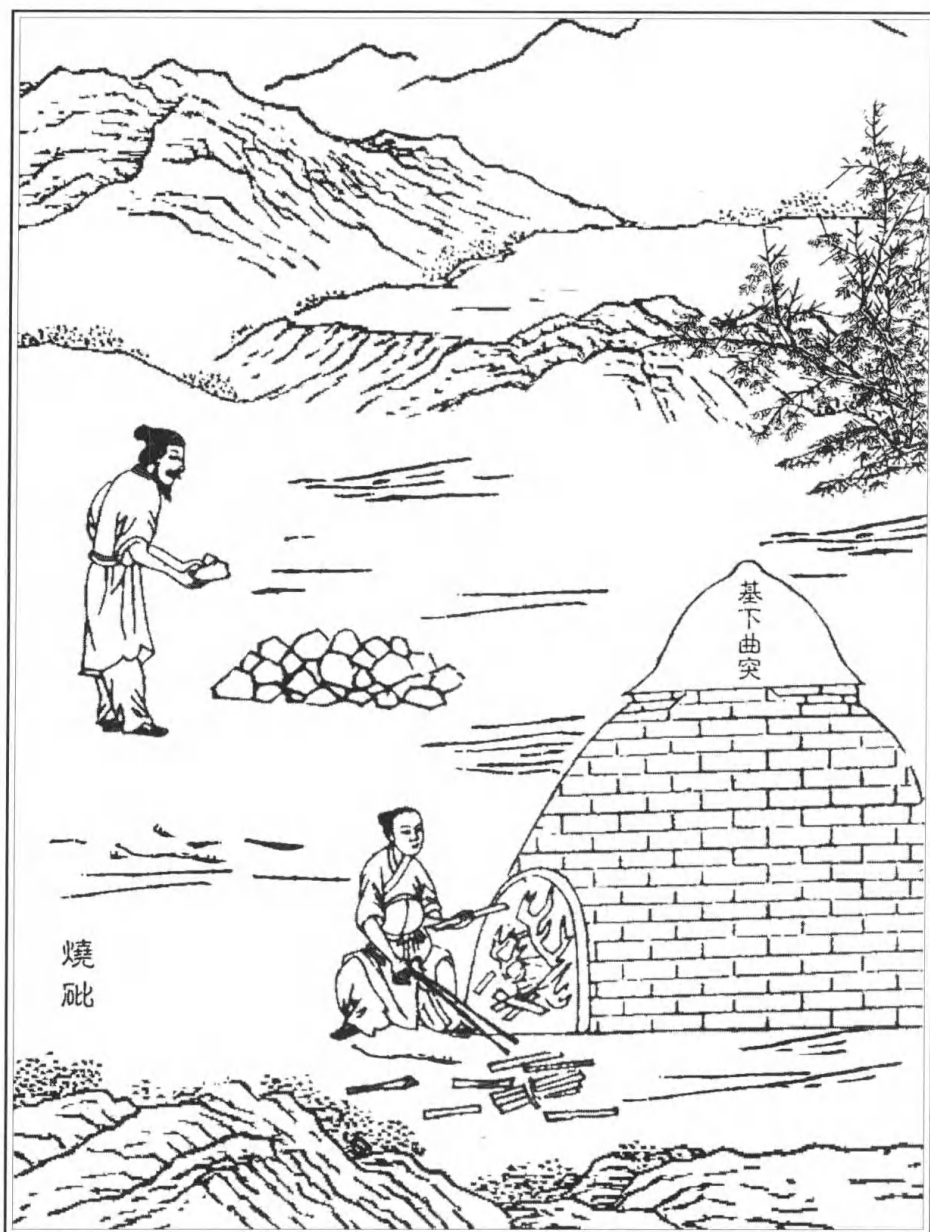
Ores used to calcine sulphur and pebbles in the coal vein are of the same shape. Dig the ore, cover it with coal cakes and pile it up, build a furnace with mud outside. Put one thousand *jin* of coal and one thousand *jin* of ore in the furnace, cover the top of the furnace with waste dross with top hunches in the middle and open a round hole in it. When the fire in the furnace is raging, there will be golden flames and vapor coming out of the hole. A porcelain bowl has been previously prepared, which rises in the center and has a rim that is turned over like a bag. This bowl is now placed on the hole of the furnace. When the essence of the sulphur stone is heated, it escapes in the form of a yellow vapor. This being stopped by the bowl, the yellow vapor then turns into liquid form, adheres to the bottom of the bowl, and flows into the baglike rim from which it flows through a small aperture into a clay pipe and thence into a small tank where it crystallized into sulphur.

When calcining black vitriol with pebbles in the coal vein, cover the top in the same method used to get sulphur when the yellow vapor comes up. Getting one *jin* of sulphur will reduce black vitriol by more than thirty *jin*. When components in vitriol turn into sulphur, what is left becomes the waste. Among the source materials of the gunpowder, sulphur is pure positive (*yang*) and saltpeter is pure negative (*yin*). Combine the two, and there will be sound and change. This is magic made by the power of pure positive and pure negative. There is no sulphur produced in the north where minorities live. Even if there is sulphur, they don't know how to calcine it. Novel cannons were also invented in the Western countries, which proves that sulphur is produced



烧硫黄

Calcination of pyritic stones for sulphur



烧砒

Production of arsenic through calcinations of minerals



【原文】

遂为弃物。凡火药，硫为纯阳，硝为纯阴，两精逼合，成声成变，此乾坤幻出神物也。硫黄不产北狄，或产而不知炼取，亦不可知。至奇炮出于西洋与红夷，则东徂西数万里，皆产硫之地也。其琉球土硫黄、广南水硫黄，皆误记也。

砒 石

凡烧砒霜质料，似土而坚，似石而碎，穴土数尺而取之。江西信郡、河南信阳州皆有砒井，故名信石。近则出产独盛衡阳，一厂有造至万钧者。凡砒石井中，其上常有绿浊水，先绞水尽，然后下凿。砒有红、白两种，各因所出原石色烧成。

凡烧砒，下鞠土窑，纳石其上，上砌曲突，以铁釜倒悬覆突口。其下灼炭举火，其烟气从曲突内熏贴釜上。度其已贴一层，厚结寸许，下复熄火。待前烟冷定，又举次火，熏贴如前。一釜之内数层已满，然后提下，毁釜而取砒。故今砒底有铁沙，即破釜滓也。凡

【今译】

这就是靠着至阳和至阴的力量变幻出来的神奇之物。硫黄不产于北方少数民族地区，即使产硫而不会炼制，亦未可知。西洋与荷兰出产新奇火炮，则说明东西方圆数万里内，都有产硫黄的地方。至于琉球的土硫黄、广南的水硫黄，则均属错误的记载。

砒 石

烧制砒霜的原料砒石，像土但比土硬，像石但比石碎，掘土数尺便可得到。江西广信、河南信阳都有砒井，因此称为信石。最近生产最多的只有衡阳，一个厂家竟有年产达一万斤的。产砒石的井中，水面上常有绿色的浊水，要先将水汲尽，然后再下井挖取。砒霜有红、白两种，各由原来的红、白砒石烧成。

烧制砒霜时，在地下挖一土窑，将砒石放入其中，窑的上部装上弯曲的烟囱，用铁锅倒过来盖在烟囱口上。下面引火烧柴，烟气经过烟囱熏贴在倒放的铁锅上。估计积结物已贴一层，达到一寸厚时，下面熄火。待出来的烟气冷却，再第二次点火，照前法熏贴。这样反复几次，一锅之内已经结满了好几层，然后将铁锅取下打碎，



everywhere in the East and West, over a distance of tens of hundreds of *li*. The “native sulphur” in Ryukyu Islands and the “water sulphur” in Guangdong Province are only false records in books.

Arsenic Stones

The source material of arsenic is arsenic stones, which are like mud, but harder than mud, and like stones, but brittler than stones. They can be obtained by digging the earth several *chi* deep. There are arsenic wells in Guangxin in Jiangxi Province and Xinyang in Henan Province, so they are called “the *Xin* stones”. Recently, only Hengyang produces the most amount of arsenic, with one factory producing ten thousand *jin* a year! In arsenic wells, there is green turbid water on the surface. Pump the water out thoroughly first and then go down into the wells to dig out the arsenic stones. There are two kinds of arsenic, red arsenic and white arsenic, which are made from red and white arsenic stones respectively.

To make arsenic, first dig a kiln in the ground and put arsenic stones in it. Then fix a winding chimney on the top and cover the chimney with an upsidedown iron pot. After that light firewood at the bottom. Fumes will go through the chimney and cling to the pot. When the condensed layer is estimated to be one *cun* thick, extinguish the fire. After this layer is completely cold, start the fire again. Repeat the process several times, and there will be several layers. The iron pot is then taken down, broken apart, and arsenic is obtained. The little bits of iron we see in the arsenic at the bottom of the pot are the fragments from the broken pot. This is the only way to make white arsenic, but there is another way to calcine red arsenic. That is, when calcining silver-copper ore which contains arsenic in a refining furnace, there are



【原文】

白砒只此一法。红砒则分金炉内银铜恼气有闪成者。

凡烧砒时，立者必于上风十余丈外。下风所近，草木皆死。烧砒之人经两载即改徙，否则须发尽落。此物生人食过分厘立死。然每岁千万金钱速售不滞者，以晋地菽、麦必用拌种，且驱田中黄鼠害。宁、绍郡稻田必用蘸秧根，则丰收也。不然，火药与染铜需用能几何哉！

【今译】

就可得到砒霜。因此靠锅底的砒霜内有铁沙，就是破锅渣。烧制白砒只有这一种方法。而红砒还有另一方法，即在分金炉内炼含砒的银铜矿石时，由逸出的气体凝结而成。

烧砒时，操作的人必须站在上风十余丈以外的地方。下风所及之处，草木皆死。烧砒的人经两年之后就要改业，否则胡须和头发都要落光。此物人食少许就会致死。然而，每年产值却成千上万，都能很快售出而不滞销。这是因为山西等地种豆类和麦类要用砒霜拌种，而且可用砒驱除田中的黄鼠害。浙江宁波、绍兴的稻田必须用砒霜蘸稻秧，以确保丰收。要不然，光制造火药与炼白铜，能需要多少砒霜呢！



fumes coming out. When the fumes coagulate, red arsenic is obtained.

When calcining arsenic, the operators must stand more than ten *zhang* away from windward side of the kiln. Trees and grass on the leeward side of the kiln will die. The operators have to change their profession after two years, otherwise all their beards and hair will fall out. Eating a little bit of it will cause death. However, its annual sale amounts to tens of thousands of *liang* of silver without any stock, this is because bean seeds and wheat seeds in Shanxi Province should be mixed with arsenic to protect them. Moreover, arsenic can be used to get rid of ground squirrels. In Ningbo and Shaoxing in Zhejiang Province, rice seedlings in the rice fields have to be dipped with arsenic in order to get a good harvest. Otherwise, there is little need for arsenic for making gunpowder and dyeing copper to a whitish color.



天工开物·卷下

杀青第十三

【原文】

宋子曰，物象精华、乾坤微妙，古传今而华达夷，使后起含生目授而心识之，承载者以何物哉？君与臣通，师将弟命，凭借咕咕口语，其与几何？持寸符、握半卷，终事詮旨，风行而冰释焉。覆载之间之借有楮先生也，圣顽咸嘉赖之矣。身为竹骨与木皮，杀其青而白乃见，万卷百家，基从此起，其精在此，而其粗效于障风、护物之间。事已开于上古，而使汉晋时人擅名记者，何其陋哉。

纸 料

凡纸质用楮树（一名穀树）皮与桑穰、芙蓉膜等诸物者为皮纸。

【今译】

宋子说，人间事物的精华和自然界的奇异奥妙，从古代传到今天，从中原传到边疆，使后世人通过阅读文献而心领神会，是靠什么材料记载下来的呢？君臣间授命请旨、师徒间传业受教，如果只靠附耳细语，又能表达多少呢？但只要有一张纸本文件、半卷书本，便足以说清意图和道理，政令可迅速下达、疑难可彻底解决。大地之间大有赖于被称为“楮先生”的纸，所有人不管聪明与否都受惠于此物。纸以竹秆和树皮为原料，除去其青皮而制成白纸。诸子百家的万卷图书都借助于纸而传世，精细的纸用在这方面，而粗糙的纸则用以糊窗和包装。造纸术起源于上古，而有人认为是汉、晋时某个人所发明，这是何等浅陋的见解！

造纸原料

凡以楮树（一名穀树）皮与桑皮、木芙蓉皮等皮料造出的纸，叫

Volume III

Chapter 13

Paper Making

Songzi says that the descendents are able to learn and understand the essence of the world and incredible wonders of nature through reading, which has been passed down from ancient times till now, from the Central Plains to the border areas. However, what materials were used for the recording? How much information could be delivered between lord and liegeman, or teacher and student if we just depended on the spoken languages? But by using a piece of paper or half a volume of writing, teaching can be achieved and government orders can be carried out very easily. There is a kind of paper known as Mr. Zhu's paper across the country. It is beneficial to everyone no matter whether he is smart or not. Paper is made from bamboo sticks and cortices whose green barks are removed to make white paper. Thousands of volumes of books of specialists and schools of thought are handed down by paper. The refined paper is used for this purpose, while the rough is for window stuffing and wrapping. Paper making originated in ancient times, while some believe it was invented by some individuals in the Han or Jin Dynasty. What a naive opinion it is!

Raw Materials for Making Paper

There are different types of paper. Bark paper is made from the bark of the paper-mulberry trees (called "grain trees"), silk-mulberry fibre, or cotton rose hibiscus. Bamboo paper is made from bamboo fibre. Re-





【原文】

用竹麻者为竹纸。精者极其洁白，供书文、印文、柬、启用。粗者为火纸、包裹纸。所谓杀青，以斩竹得名，汗青以煮沥得名，简即已成纸名，乃煮竹成简。后人遂疑削竹片以纪事，而又误疑韦编为皮条穿竹札也。秦火未经时，书籍繁甚，削竹能藏几何？如西番用贝树造成纸叶，中华又疑以贝叶书经典。不知树叶离根即焦，与削竹同一可晒也。

造 竹 纸

凡造竹纸，事出南方，而闽省独专其盛。当笋生之后，看视山窝深浅，其竹以将生枝叶者为上料。节届芒种则登山砍伐。截断五七尺长，就于本山开塘一口，注水其中漂浸。恐塘水有涸时，则用竹枧通引，不断瀑流注入。浸至百日之外，加工槌洗，洗去粗壳与青

【今译】

皮纸。用竹纤维造的，为竹纸。精美的纸极其洁白，供书写、印刷、书信、文书之用。粗糙的纸作火纸和包裹纸。所谓“杀青”，是从砍竹而得到的名称，“汗青”则从蒸煮而得其名，“简”是指已制成的纸。因为煮竹成简，后人遂误以为削竹片可以记事，还更误以为“韦编”的意思就是用皮条穿在竹简上。秦始皇未焚书以前，有很多书籍，如用竹片记事，又能记多少东西？还有，西域国家有用贝树造成贝叶，中国又有人认为贝叶可用来写佛经。岂不知树叶离根即焦枯，这种说法与削竹片记事之说是一样可笑的。

造 竹 纸

造竹纸多在南方，而福建省最为盛行。当竹笋生出后，先观察山沟里竹林的长势，以将要生枝叶的竹为上料。快到芒种时，则登山砍竹。将竹秆截断成五至七尺长，在本山就地开塘一口，向其中注水以浸沤竹料。为避免塘水干涸，则用竹管引水，不断注入山上流下来的水。沤至百日以上，将竹从塘内取出加工槌洗，洗去粗壳



finer paper is incredibly white and used in writing, printing, and writing letters. The rough paper is used as paper of burnt offerings or wrapping paper, the so-called “*Shaqing*” refers to the chopping down of the bamboo plants; “*Hanqing*” refers to cooking and straining the bamboo fibre, and “*Jian*” refers to the finished paper. “*Jian*” therefore were made by cooking the bamboo. However in later ages, people mistakenly thought that the “*Jian*” meant pieces of bamboo slats and thus got at the wrong conclusion that the term “*Weibian*” is actually attaching leather pieces onto chopped bamboos. Before the first emperor of the Qin Dynasty ordered to burn the existing books there were already lots of books. If we made records with bamboo pieces, how many could be recorded? In addition, it was said countries in the west made paper out of palm leaves, and some Chinese believe that the leaves can be used to write Buddhist scriptures. They all ignore the fact that the leaves wither easily. Hence this saying is as ridiculous as the idea of books made of bamboo slats.

Making Bamboo Paper

Bamboo paper making prevails in the south, and it is mostly popular in Fujian Province. People would observe the growing of bamboo shoots and select those shoots with branches and leaves as the best material for making paper. Around Grain in Beard, they chop down bamboos in the mountains. Bamboo sticks are chopped up to 5-7 *chi*. They would dig a pool on the spot and fill it with water for retting. To prevent a pool from drying up, a bamboo pipe is used to carry water flowing down from the mountain top. After 100 days, the bamboo is taken from the pool for further processing and the rind and green skins are removed by washing (This process is called killing the green). Bamboo



砍竹漂塘

Steeping and washing the cut bamboo



棹桶蒸竹

Cooking the inner mass of bamboo in a pot



【原文】

皮（是名杀青）。其中竹穰形同苎麻样。用上好石灰化汁涂浆，入槿桶下煮，火以八日八夜为率。

凡煮竹，下锅用径四尺者，锅上泥与石灰捏弦，高阔如广中煮盐牢盆样，中可载水十余石。上盖槿桶，其围丈五尺，其径四尺余。盖定受煮，八日已足。歇火一日，揭槿取出竹麻，入清水漂塘之内洗净。其塘底面、四维皆用木板合缝砌完，以防泥污（造粗纸者，不须为此）。洗净，用柴灰浆过，再入釜中，其中按平，平铺稻草灰寸许。桶内水滚沸，即取出别桶之中，仍以灰汁淋下。倘水冷，烧滚再淋。如是十余日，自然臭烂。取出入臼受舂（山国皆有水碓），舂至形同泥面，倾入槽内。

凡抄纸槽，上合方斗，尺寸阔狭，槽视帘，帘视纸。竹麻已成，槽内清水浸浮其面三寸许，入纸药水汁于其中（形同桃竹叶，方语无定名），则水干自成洁白。凡抄纸帘，用刮磨绝细竹丝编成。展卷张开

【今译】

与青表皮（这叫杀青），其中竹纤维的形状就像苎麻一样。用上好的石灰化成灰浆，涂于竹料，放入槿桶蒸煮，一般蒸煮八昼夜。

蒸煮竹料的锅直径四尺，锅上用泥与石灰封固边沿，高、宽类似广东煮盐的牢盆，内可盛水十多石。上面盖上槿桶，其圆周一丈五尺，直径四尺多。盖定之后，蒸煮八日已足。歇火一日后，打开槿桶取出竹料，入清水漂塘里面洗净。塘的底面及四周皆用木板合缝砌好，以防遇到泥污（造粗纸时不须如此）。洗净后，再用柴灰水将竹料浆透，再放入锅中压平，上面平铺稻草灰一寸左右。桶内水滚沸后，将竹料取出放入另一槿桶中，仍以灰水淋下。如灰水冷却，烧滚后再淋。这样经过十多天后，竹料自然蒸烂。取出入臼中捣碎（山区都有水碓），舂至形同泥面状，倒入纸槽中。

抄纸槽的形状像一个方斗，其尺寸宽窄，槽根据纸帘而定，而纸帘又根据纸的尺幅而定。竹料既已制成，便向槽内放清水，水面高出竹料三寸，然后加入纸药水（形同桃竹叶，各地名称不一），则纸脱水后自然洁白。抄纸帘用刮磨绝细的竹丝编成，纸帘展开后，下有长方形



fibre resembles the shape of ramie. Then paint bamboos with the best lime milk and boil in a big barrel for 8 days and nights.

The diameter of the cauldron should be 4 *chi* long, and its edges fixed with mud and lime. Its height and width are similar to the tub for boiling salt in Guangdong Province, with a capacity of over 10 *dan* of water. The cauldron is covered with a big barrel containing all sorts of bamboo materials, whose circle is of one *zhang* and five *chi*, and whose diameter is over 4 *chi*. The boiling is finished in 8 days. Then wait one more day before taking the bamboo materials out of the big barrel and washing them with fresh water in the pool. The bottom and sides of the pool are well-built with wood blocks without any gaps so as to prevent it from mud. (To make coarse paper, this process is not necessary.) After washing, soak materials with water mixed with firewood ash. Then press it neatly in the cauldron, spread haulm ash on it about a *cun* thick. After it is boiled, put the materials into another big barrel and drench with water mixed with ash. Wait until it cools down, repeat boiling and drenching continuously for over ten days. The bamboo pulps will rot naturally. It is then taken out to be pounded in a mortar until it turns to dough.

The shape of the pulp tank is a square framework. The size of the tank is determined by the size of the paper-making screen to be used, which in turn is determined by the size of the paper sheets to be made. When the bamboo materials are processed, fill the tank with clean water and then a chemical solution is added (which seems like leaves of peach-bamboo, with different names in different places). This chemical solution can bleach the paper sheets to a white color when the paper is dry. Paper-making screen is made of bamboo filament scrapped and rubbed to be very thin and, when spread, it is supported by a rectangular frame un-



【原文】

时，下有纵横架框。两手持帘入水，荡起竹麻入于帘内。厚薄由人手法，轻荡则薄，重荡则厚。竹料浮帘之顷，水从四际淋下槽内。然后覆帘，落纸于板上，叠积千万张。数满则上以板压，拴绳入棍，如榨酒法，使水气净尽流干。然后以轻细铜镊逐张揭起焙干。凡焙纸，先以土砖砌成夹巷，下以砖盖巷地面，数块以往即空一砖。火薪从头穴烧发，火气从砖隙透巷，外砖尽热，湿纸逐张贴上焙干，揭起成帙。

近世阔幅者名大四连，一时书文贵重。其废纸洗去朱墨、污秽，浸烂入槽再造，全省从前煮浸之力，依然成纸，耗亦不多。南方竹

【今译】

框架支撑。两手持帘入纸浆水中，将竹纤维荡起并抄入帘内。纸的厚薄由人的手法而定，轻荡则薄，重荡则厚。竹料浮在帘上时，水从四边下流到槽内。然后翻转纸帘，使纸落于木板上，叠积成千上万张。数目足时，则在湿纸上放一木板以便压榨，拴上绳子插入撬棍，像榨酒那样使纸内水分压净流干。然后轻轻以细铜镊逐张揭起、焙干。烘纸时，先以土砖砌成夹巷，下面用砖盖夹巷底部，隔几块砖即空一砖。薪火从巷端火口烧起，火温从砖隙透过夹巷，使外面的砖都发热，将湿纸逐张贴在夹巷上烘干，揭下叠起。

近世有一种宽幅纸，叫“大四连”，一时看重作书写纸。将废纸洗去朱墨、污秽，漂洗、打烂后入槽再行抄造，可节省前述操作过程中的蒸煮、沤浸的工序，依然可以造成纸，消耗亦不多。南方竹贱之



derneath. The worker has to hold the screen with both hands and puts it into the paper pulpy water and the bamboo fibres in the pulp tank so that some of the latter remains on top of the screen. The thickness of the paper depends on how the screen is manipulated. Often a shallow submerging results in a piece of thin paper, while a deeper dipping makes a thick one. When bamboo materials float on the screen, water will flow into the tank from all around the screen's edges. Then the screen is inverted and the paper is made to fall on the wooden board and pile up to thousands. When the number is enough, put a board on top of the wet paper, tie it with ropes and insert a stick, in order to squeeze the water out of the paper just like a wine press which can squeeze wine. And then expose it and bake it piece by piece with a small copper tweezer. To dry paper, a double wall of bricks is built. The ground between the two rows should be covered by bricks. In the bottom of the wall, holes are left by the spaced omission of bricks. When a fire is lighted at the first hole, the heat will travel through the apertures and spread to the wall surfaces where the bricks will become hot. The wet sheets of paper are spread onto the wall piece by piece, baked dry, and then taken off as finished products.

In recent ages there is a wide-size paper, known as "Large Four-fold" which is highly valued as writing paper. To make new paper with used and waste paper, first wash off the ink and colors of the paper, and then put the paper in water. The paper is melted to pulp when it soaks in water and is transferred to the pulp tank for the purpose of making new paper. This procedure of paper making not only reduces the expensive operations of cooking and straining, but also wastes very little. Southern people look down upon this method, because bamboo is abundant and cheap there. While in the north the small piece of



【原文】

贱之国，不以为然。北方即寸条片角在地，随手拾取再造，名曰还魂纸。竹与皮，精与粗，皆同之也。若火纸、糙纸，斩竹煮麻，灰浆水淋，皆同前法。唯脱帘之后不用烘焙。压水去湿，日晒成干而已。

盛唐时鬼神事繁，以纸钱代焚帛（北方用切条，名曰板钱），故造此者名曰火纸。荆楚近俗有一焚侈至千斤者。此纸十七供冥烧，十三供日用。其最粗而厚者名曰包裹纸，则竹麻和宿田晚稻稿所为也。若铅山诸邑所造束纸，则全用细竹料厚质荡成，以射重价。最上者曰官束，富贵之家通刺用之。其纸敦厚而无筋膜，染红为吉束，则以白矾水染过，后上红花汁云。

造 皮 纸

凡楮树取皮，于春末夏初剥取。树已老者，就根伐去，以土盖

【今译】

地，不以为然。而北方即使是寸条片角的纸落在地上，也随手拾起再行造纸，名叫“还魂纸”。竹纸与皮纸，精纸与粗纸，都用相同方法制造。至于火纸、粗糙纸的制造，砍竹、煮竹料，用灰浆和灰水淋，皆与前述方法相同。唯独纸从帘上脱下后，不用烘焙，压去水分后靠太阳晒干而已。

盛唐时，敬鬼神之事很繁多，烧纸钱以代替烧帛（北方用切条，名为板钱），故这种纸名曰火纸。荆楚一带近来流行的习俗，一次烧掉上千斤火纸。这类纸十分之七供祭祀时烧去，十分之三供日用。其中最粗而厚的名叫包裹纸，用竹料和隔年晚稻秆制成。至于江西铅山等地所造束纸，则全用细竹料加厚抄成，以谋高价。最好的叫官束纸，富贵之家作名片用。纸质厚实而无筋头，染红后作办喜事的吉束纸。先以白矾水染过，再染上红花汁。

造 皮 纸

剥取楮树皮在春末、夏初之际进行。树已老的，在近根部位将



paper will not be wasted and will be used to make new paper again, which is called "Paper revived from Death". When making paper, people use the same method, whether making bamboo paper or bark paper, refined paper or coarse paper. As to the making of burnt-offering paper and coarse paper, the process of cutting down the bamboo, cooking and straining the fibres with ash solutions and washing the fibres with water, are the same as discussed before. Wet paper, however, is not baked dry after the sheets are taken off the screen, but are first pressed to remove the excess water and then dried in the sun.

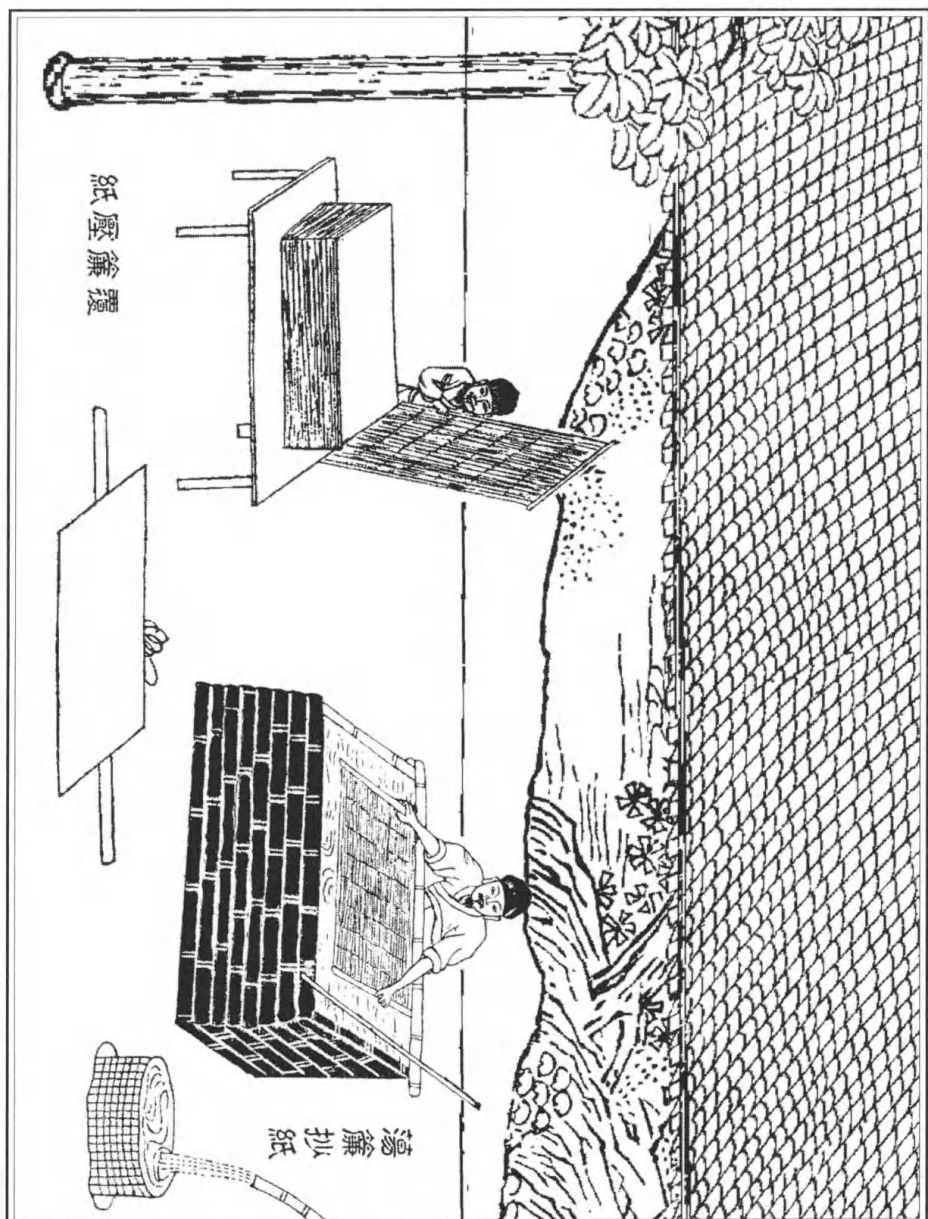
The "burnt-offering" paper is so-called because during the Tang Dynasty, people were much concerned about religious worship. They burn large amounts of sacrificial paper money instead of "burnt silk". (People in North China make such money by cutting paper into strips, which is called "cut money".) Around Hubei and Hunan a custom prevailed recently, i. e., a thousand *jin* of paper or more are wastefully burned. Seventy percent of this paper is used for burnt offerings and thirty percent for daily use. The coarsest and thickest is paper called wrapping paper, which is produced with a mixture of bamboo fibres and rice stalks. As to the paper for invitations made in Qianshan area of Jiangxi Province, it is all made from sliced bamboo and thickened in order to make more profit. The best of it is called the official invitation paper and is used as business card among the rich. The paper is thick and solid. When in red color, it can be used for invitations to happy occasions. It is first treated with alum water and then dyed red with safflower juice.

Making Bark Paper

In the season of late spring and early summer, people strip the

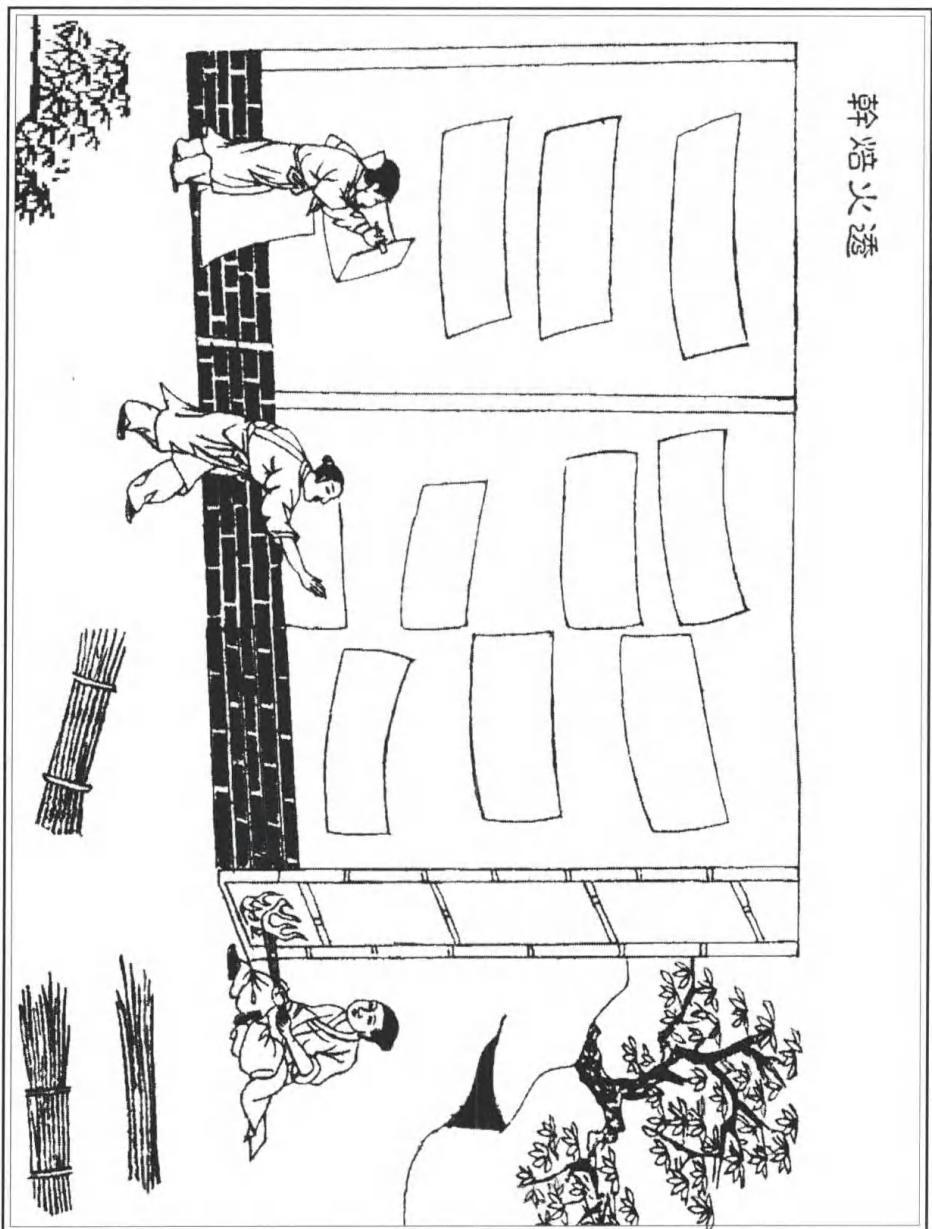


荡帘抄纸 覆帘压纸
Collecting bamboo pulp on top of a screen
Removing and pressing paper sheets





干焙火透



焙纸

Drying paper sheets



【原文】

之。来年再长新条，其皮更美。凡皮纸，楮皮六十斤，仍入绝嫩竹麻四十斤，同塘漂浸，同用石灰浆涂，入釜煮糜。近法省啬者，皮、竹十七而外，或入宿田稻稿十三，用药得方，仍成洁白。凡皮料坚固纸，其纵文扯断如绵丝，故曰绵纸。衡断且费力。其最上一等供用大内糊窗格者，曰棧纱纸。此纸自广信郡造，长过七尺，阔过四尺。五色颜料，先滴色汁槽内和成，不由后染。其次曰连四纸，连四中最白者曰红上纸。皮、竹与稻稿掺和而成料者，曰揭帖呈文纸。

芙蓉等皮造者，统曰小皮纸，在江西则曰中夹纸。河南所造，未详何草木为质，北供帝京，产亦甚广。又桑皮造者曰桑穰纸，极其敦厚。东浙所产，三吴收蚕种者必用之。凡糊雨伞与油扇，皆用

【今译】

树砍去，以土盖上。待来年再长新条，其皮更美。造皮纸时，用楮皮六十斤，加入绝嫩竹料四十斤，同样在塘内漂浸，再用石灰浆涂，放入锅中煮烂。近来节省者用树皮、竹料十分之七外，另加隔年稻秆十分之三，如用药得当，仍能造成洁白的纸。结实的皮料纸，其纵纹扯断后如绵丝，故称“绵纸”。横向扯断较费力。其最上一等纸供宫内糊窗格的，叫“棧纱纸”。此纸在广信府制造，长大于七尺，宽过四尺。各种颜料用法是先将色汁放入槽内与纸浆和匀，不是成纸后再染。其次是连四纸，连四纸中最白的叫“红上纸”。以皮、竹与稻秆掺和而成料的，叫“揭帖呈文纸”。

用木芙蓉等树皮造的纸，统统叫“小皮纸”，而在江西则称“中夹纸”。河南所造的纸，不知用什么原料，北运供京师用，产量相当大。还有用桑皮造的纸叫桑穰纸，极其厚实，浙江东部所产的桑皮纸，为苏州、常州、湖州收蚕种时所必需。糊制雨伞与油扇，都用



bark from trees. For old trees, cut it near the root and cover it with mud. When it grows in the next year, the bark will be better. To make bark paper, 60 *jin* of paper mulberry bark and 40 *jin* of tender bamboo are first mixed together in the pond and covered with lime juice, and then boiled in a pot and finally turned to pulp. In order to be economical, recently some people use 70% bark and bamboo and 30% rice stalks to make bark paper. After some suitable chemicals are added, however, white paper can be obtained. The strong bark paper will show ragged ends like cotton fibres, therefore it is called "cotton paper". It is difficult to tear this paper crosswise. The best grade of the paper is used to paper the windows of the Imperial Palaces and is called "window gauze" paper. This kind of paper is made in Guangxin Prefecture and it is 7 *chi* long and 4 *chi* wide. It is dyed in various colors by adding coloring materials to the pulp tank. Dyeing is done before the sheets have been formed. The second is the "fourfold" paper, of which the whitest is called red "superior" paper. The bark paper made from a mixture of bark, bamboo and rice stalks, is called "document" paper.

Another kind of paper, made from the barks of cotton rose hibiscus stems, is called "small bark" paper, but in Jiangxi Province it is called "middle" paper. The paper made in Henan Province, whose materials are unknown, is sent to Beijing for use. It has a mass production. Another kind of paper made from *Cortex mori* is called mulberry paper, which is very thick. Mulberry paper produced in the east of Zhejiang Province is required for collecting silkworm eggs in Suzhou, Changzhou, and Huzhou. "Small bark" paper is used for producing umbrellas and oil-paper fans. If wide bark paper is needed, the paper channel containing sizing materials must be wide. Large paper curtains cannot be lifted by only one person. Two persons are needed. And sev-



【原文】

小皮纸。凡造皮纸长阔者，其盛水槽甚宽。巨帘非一人手力所胜，两人对举荡成。若棧纱，则数人方胜其任。凡皮纸供用画幅，先用矾水荡过，则毛茨不起。纸以逼帘者为正面，盖料即成泥浮其上者，粗意犹存也。

朝鲜白碇纸不知用何质料。倭国有造纸不用帘抄者，煮料成糜时，以巨阔青石覆于炕面，其下熬火，使石发烧。然后用糊刷蘸糜，薄刷石面，居然顷刻成纸一张，一揭而起。其朝鲜用此法与否，不可得知。中国有用此法者，亦不可得知也。永嘉蠲糲纸亦桑穰造。四川薛涛笺亦芙蓉皮为料煮糜，入芙蓉花末汁。或当时薛涛所指，遂留名至今。其美在色，不在质料也。

【今译】

小皮纸。造宽幅的皮纸，装浆料的纸槽也必定宽大。大的纸帘不是一人手力所能提起，要两人对举纸帘抄造。要是棧纱纸，则须数人举帘才能胜任。供作书画用的皮纸，先要用明矾水荡过，则不起毛。纸以贴近竹帘的一面为正面，因泥料都浮在上面，故比较粗糙。

朝鲜白碇纸不知用什么原料。日本国有造纸不用帘抄的，将料煮烂后，以宽大的青石放在炕上，下面烧火，使石发烧，然后用刷子蘸纸浆，薄薄地刷在石面上，居然立刻成纸一张，一揭而起。朝鲜是否用此法造纸，不得而知。中国是否有用此法的，也不清楚。永嘉县的蠲糲纸，也用桑皮制造。四川薛涛笺，也是用木芙蓉树皮为料而煮烂，再加芙蓉花的汁。这种纸或许是当时薛涛所设计，遂留名至今。其美在颜色，而不在质料。



eral people are needed for tissue paper. When used for painting, bark paper is first sized with alum water to eliminate fluff from the surface. The side sheet which adheres to the screen is considered the right side, as the texture of the free side is inevitably rougher even though the pulp has been reduced to a state as fine as clay.

It is not known what materials are used to make “white-hammered paper” in Korea. But in Japan, paper is made without the use of screens. They use the following method: after the materials are well cooked, they put a large blue stone on the heated brick bed, below which a strong fire is burning to heat the stone. Then they dip a brush into the paper pulps and brush them onto the stone thinly. Surprisingly a piece of paper is produced. Shortly afterwards, it dries and becomes a sheet of paper which can be easily lifted. It is not known whether the same method is used in Korea or in China. The paste-impregnated paper of Yongjia is also made from silk-mulberry fibres while the Xuetao Paper in Sichuan Province is made from cotton rose hibiscus skin. To make it, the bark from hibiscus is cooked to a pulp, then the aqueous extract of powdered hibiscus flower petals is added. Maybe this kind of paper making was invented by *Xuetao* then, so he is remembered. Its beauty lies not in its quality but in the beauty of the material.



丹青第十四

【原文】

宋子曰，斯文千古之坠也，注玄尚白，其功孰与京哉？离火红而至黑孕其中，水银白而至红呈其变，造化炉锤，思议何所容也。五章遥降，朱临墨而大号彰。万卷横披，墨得朱而天章焕。文房异宝，珠玉何为？至画工肖像万物，或取本姿，或从配合，而色色咸备焉。夫亦依坎附离，而共呈五行变态，非至神孰能于斯哉？

朱

凡朱砂、水银、银朱，原同一物。所以异名者，由精粗、老嫩而分也。上好朱砂出辰、锦与西川者，中即孕汞，然不以升炼。盖光

【今译】

宋子说，古代文化遗产之所以千古不灭，靠的是纸墨的文字记载，其功用实无可比拟。松木和桐油在赤火中烧出黑烟，制墨原料就孕育其中。白色水银烧炼后，变成红色银朱，成为作书画的材料。物质烧炼后所产生的变化，真是不可思议。朝廷颁至各地的五色笺敕诏，因皇帝用朱笔在黑字上作了御批，而使重大号令得以传布。披阅万卷图书，在书上用朱笔加以批注，而使本来佳作更放光彩。这样看来，朱、墨实为文房之异宝，珠玉岂能相比？画家描绘万物，或只以墨作画，或以朱、墨及其他颜料配合，画成各种彩画。朱墨与颜料的制备须借水火之力，而共同呈现于五行的变化之中，如果不是巧妙地利用自然力，谁能做到这些？

朱 砂

朱砂、水银与银朱原本是同一物质。之所以有不同名称，是因精粗、老嫩的差异。上好的朱砂出于辰州、锦州与四川，其中就含



Chapter 14

Cinnabar and Ink

Songzi says that ancient cultural heritage will never perish from the earth due to the records by paper, brush pen and ink with an incomparable effect. The material for ink is in the black smoke from the burning of deal and tung oil. The material for writing and painting shall be obtained after the white mercury is burned and refined into red cinnabar. It is really amazing after the material is burned. The five color documents of state issued by the central government, make the significant orders delivered because the emperor signs the black characters of the order by using the brush pen with red ink. To take notes with red ink while reading books makes the excellent works more brilliant. These are the treasures that belong to a study where there is no room for pearls and gems. How can the bead or jade compare with them? The painters paint various paintings by using ink only or the mixture of cinnabar, ink and other dyes. The producing of cinnabar and other dyes must depend on the power of water and fire and reveal the changes of five elements. No one can fulfill this without the use of these natural resources in a flexible way.

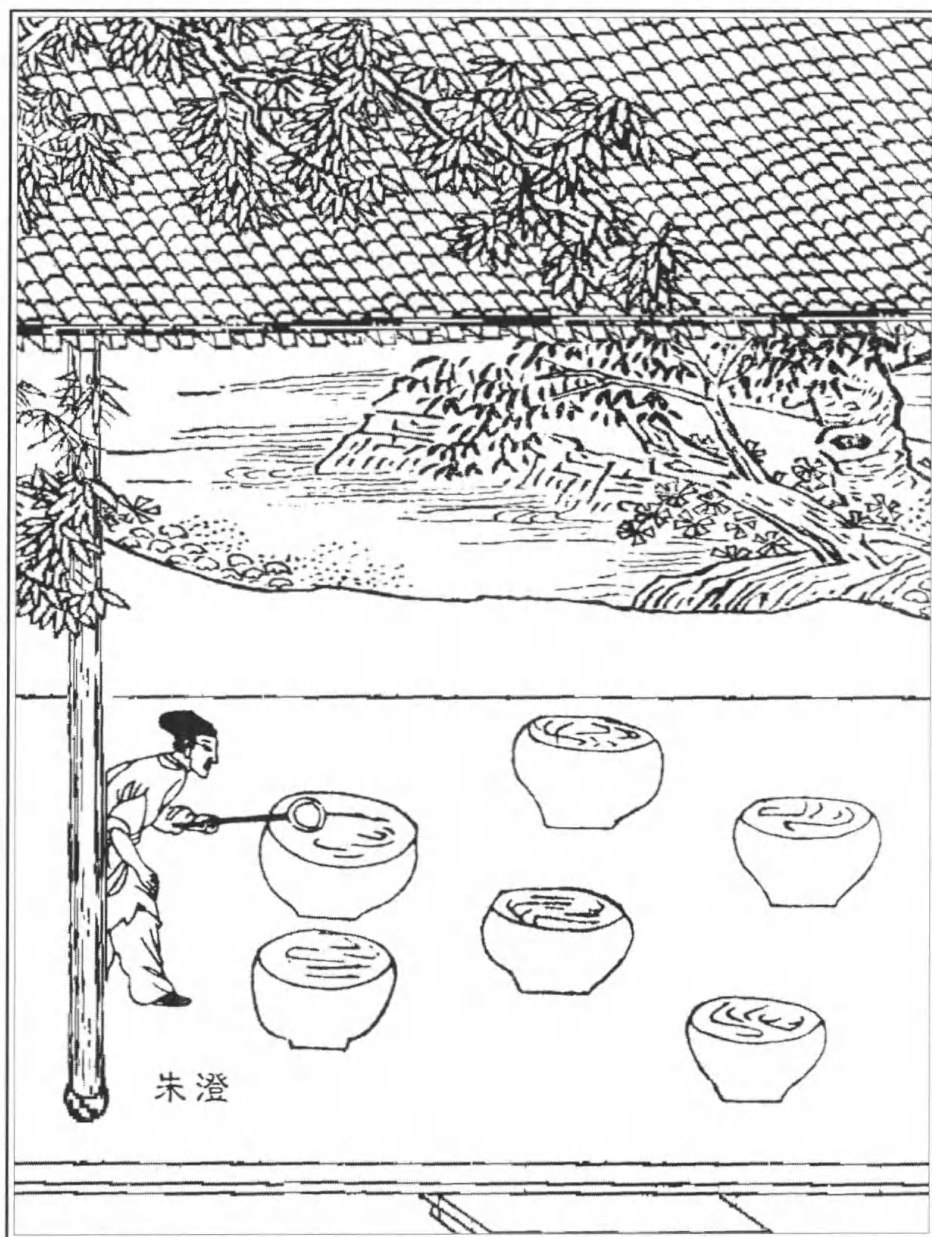
Cinnabar

Cinnabar, mercury and mercuric cinnabar are originally the same materials. They have different names due to the differences between the old and the young, the fine and the coarse. The top-class cinnabar ore is produced in Chenzhou, Jinzhou and Sichuan Province, and contains



研朱

Grinding and hydraulic classification of mercury ore



澄朱

Sublimation and condensation of mercury ore



【原文】

明、箭镞、镜面等砂，其价重于水银三倍，故择出为朱砂货鬻。若以升汞，反降贱值。唯粗次朱砂方以升炼水银，而水银又升银朱也。

凡朱砂上品者，穴土十余丈乃得之。始见其苗，磊然白石，谓之朱砂床。近床之砂，有如鸡子大者。其次砂不入药，只为研供画用与升炼水银者。其苗不必白石，其深数丈即得。外床或杂青黄石，或间沙土，土中孕满，则其外沙石自多折裂。此种砂贵州思、印、铜仁等地最繁，而商州、秦州出亦广也。凡次砂取来，其通坑色带白嫩者，则不以研朱，尽以升汞。若砂质即嫩而烁，视欲丹者，则取来时入巨铁碾槽中，轧碎如微尘。然后入缸，注清水澄浸。过三日夜，跌取其上浮者，倾入别缸，名曰二朱。其下沉结者，晒干即名头朱也。

凡升水银，或用嫩白次砂，或用缸中跌出浮面二朱，水和搓成大

【今译】

有汞，但不用来制汞。因为朱砂中的光明砂、箭镞砂及镜面砂等价钱比水银还贵三倍，故选出好朱砂来出卖。如果用这些朱砂来炼制水银，反而降低价钱。只有粗的次朱砂才用来提炼水银，再用水银升炼成银朱。

上等的朱砂，要挖土十余丈方可得到。开始露头的矿苗是一堆堆白石，叫朱砂床。矿床附近的朱砂有的大如鸡子。次等朱砂不堪入药，只供研磨作画与提炼水银用。次朱砂的矿苗不一定是白石，挖数丈即可得到。其矿床外或者杂带有青黄色石块，或者间有砂粒，堆满于土中，外层的砂石多自行破裂。这种朱砂在贵州思南、印江、铜仁等地最多，而陕西商县、甘肃秦州也有出产。开采次等朱砂时，如整个坑里都是色白而细嫩的矿石，就不用以研成朱砂，而是全用来提炼汞。若砂质虽嫩但闪有红光的，则取来放入大的铁碾槽中碾成细粉，然后在缸里用清水澄浸。经过三天三夜，将浮在上面的舀到另一缸中，名叫二朱。缸中下沉的，晒干后名曰头朱。

提炼水银，或者用白嫩的次朱砂，或者用缸中舀出浮在上面的



mercury, but cannot be used for producing mercury, because the price of the high-quality ore used in polishing arrowheads, mirrors and the like, in the cinnabar is three times higher than mercury. Thus good cinnabar would be chosen for selling instead of refining mercury that can be sold at low prices. Only the coarse red cinnabar shall be used for refining mercury, which then shall be refined to red cinnabar.

The first-class cinnabar ore can be obtained by digging more than 10 *zhang* below the earth's surface. The first appearance of its seam looks like white stones, which is called cinnabar bed. Some pieces of cinnabar ore near the mine bed are as big as hen's eggs. The inferior cinnabar is not appropriate for making medicine. But it is only suitable for rubbing and refining mercury. The seedling of inferior cinnabar is not always the white stones and can be got by digging several *zhang* below the earth's surface. The outside of the cinnabar bed is mixed with dark or yellow stones or sand and piled completely under the earth, the sand outside is always cracked automatically. This type of cinnabar is mainly produced in Si'nan, Yinjiang and Tongren, in Guizhou Province. It is also produced in Shangxian, Shaanxi Province and Qin Zhou, Gansu Province. If the ores in the pits are all white, fine and young ores while mining inferior cinnabar, they can be used exclusively for making mercury, but not be ground into cinnabar. If the quality of the ore is young but shining with red light, it will be fetched and put into big metal trough to be ground into a thin powder and finally dipped in a crock and cleaned with clean water. After three days and nights, the material floating on the top of the water will be scooped into another trough and called second-class cinnabar, the one that sinks to the bottom is dried and called first-class cinnabar.

White and young inferior cinnabars are used for refining mercury.



【原文】

盘条。每三十斤入一釜内升汞，其下炭质亦用三十斤。凡升汞，上盖一釜，釜当中留一小孔，釜旁盐泥紧固。釜上用铁打成一曲弓溜管，其管用麻绳密缠通梢，仍用盐泥涂固。煅火之时，曲溜一头插入釜中通气（插处一丝固密），一头以中罐注水两瓶，插曲溜尾于内，釜中之气达于罐中之水而止。共煅五个时辰，其中砂末尽化成汞，布于满釜。冷定一日，取出扫下。此最妙玄化，全部天机也。

凡将水银再升朱用，故名曰银朱。其法或用磬口泥罐，或用上下釜。每水银一斤，入石亭脂（即硫黄制造者）二斤，同研不见星，炒作青砂头，装于罐内。上用铁盏盖定，盏上压一铁尺。铁线兜底捆缚，盐泥固济口缝，下用三钉插地鼎足盛罐。打火三炷香久，频以

【今译】

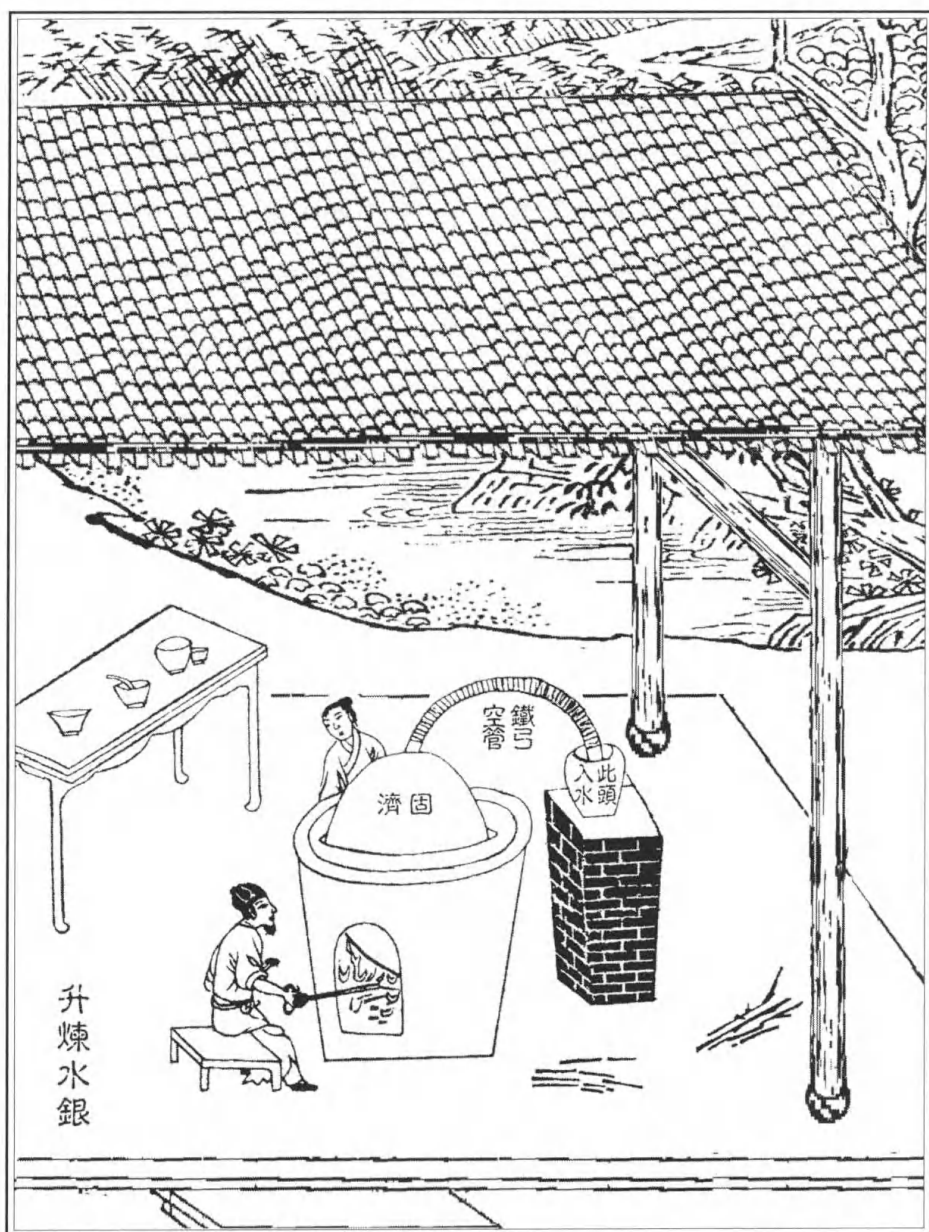
二朱，将朱砂与水拌合，搓成粗条。每三十斤装入一锅，用来提炼汞，所用柴薪也是三十斤。提炼汞的锅，上面还要扣上另一个锅，锅上正中留一小孔，旁边用盐泥封紧。锅上小孔与用铁打成的弯管相联，整个弯管都要用麻绳缠密，仍用盐泥封紧。点火时弯管的一头插入锅内通气（接口处要严密封固），弯管的另一头插入装有两瓶水的罐内，锅内之气通到罐中之水而受冷却。共加火五个时辰，锅内的朱砂粉就都变成汞而布满于锅壁。冷却一日后，再取出扫下。这颇为玄妙的变化，包含着自然界物质变化的全部奥秘。

有的朱砂是从水银再炼制成的，故名曰银朱。其方法是或者用敞口的泥罐烧炼，或者是用一上一下的两口锅。每一斤水银加入石亭脂（硫黄制成的）二斤，放在一起研细至见不到水银珠，用火炒成青色粒状，装入罐内。罐口用铁盘盖紧，铁盘上压一铁尺。用铁线将铁盘与罐底捆紧，再用盐泥封住所有接缝。下面用三根铁棒插在地上，鼎足而立以架起罐子。点火煅烧，约点燃三炷香所需的时间。在这期间，



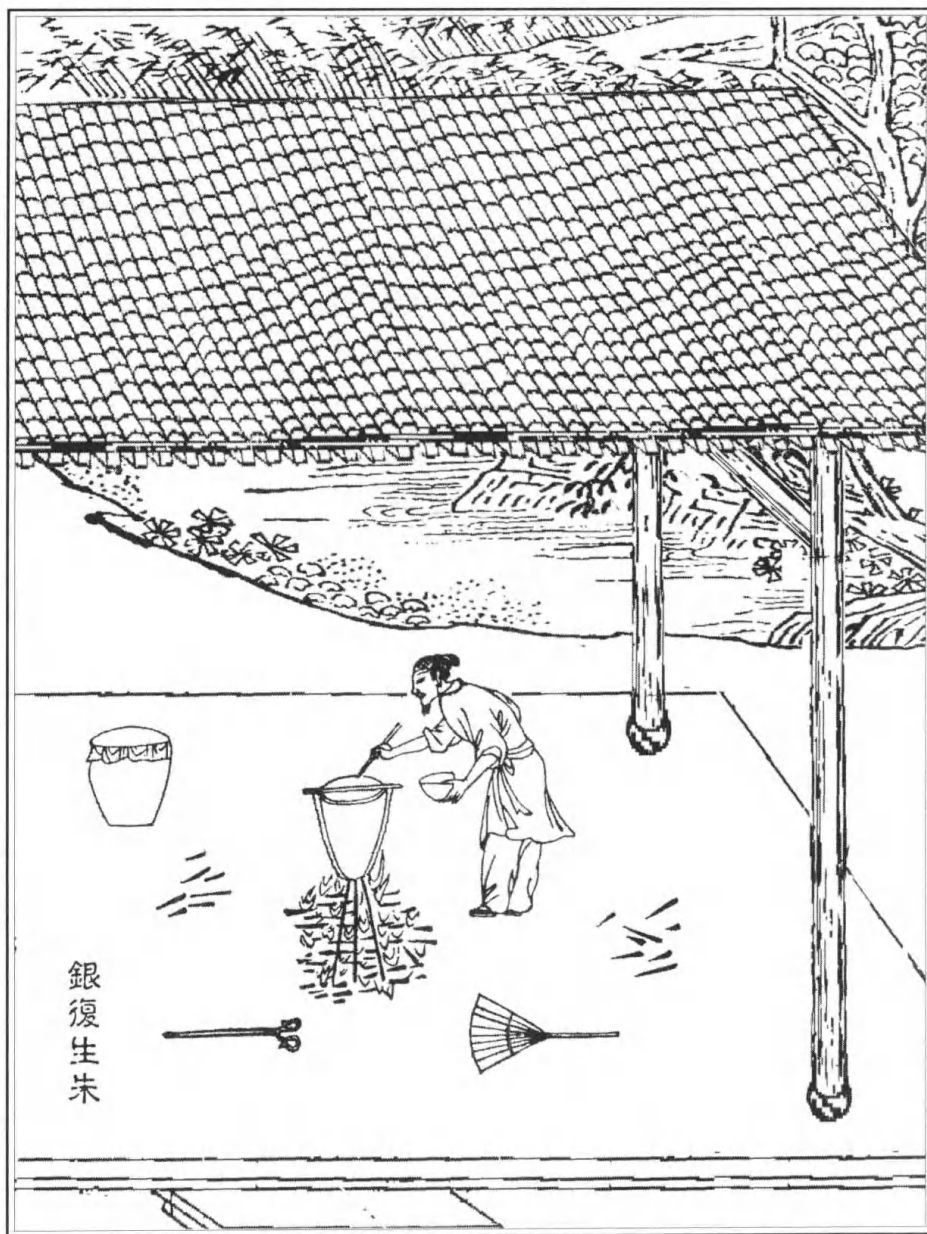
Second-class cinnabar scooped from the crock can also be mixed with water and twisted into thick sticks to refine mercury. Every 30 *jin* are put into one pot to refine mercury and the charcoal needed for this is also 30 *jin*. The pot is covered with a smaller pot with a slot in the center and salted mud enveloped tightly around it. The slot is connected with a bent metal pipe which is twisted with a hemp rope and enveloped with salted mud. One end of the bent pipe is inserted into the pot and enveloped tightly and densely (the inserted part should be tightly sealed). The other end is inserted into the jar with two bottles of water, and the air in the pot is refrigerated when it reaches the water in the jar. With five hours' heating, the cinnabar inside the pot will have turned into mercury around the wall of the pot. It can be swept down after cooling down for one day. This procedure with extremely occult principles displays the whole mystery of the changes of nature.

Some cinnabar is re-refined from mercury, so it is called "mercuric cinnabar". This is usually produced by burning and refining mercury either in an open-mouthed mud-jar or in two pots with one above the other. Every *jin* of mercury is mixed with two *jin* of red sulphur stones (from which sulphur is made). Then they will be put together for grinding until the drops of mercury disappear and finally be roasted to green kernels and put into the jar with a metal tray above which is pressed by a metal ruler. The metal tray and the bottom of the jar are tied tightly together and all the seams are enveloped with salted mud. The jar is supported by three metal sticks inserted into the ground and then heated with fire for about the duration of the complete burning of three sticks of incense. Light the fire and it takes about 3 hours. During this period the metal tray is constantly dripped with cold water from ropey writing brush so that the "mercuric cinnabar" powder will natu-



升煉水銀

Sublimation and condensation of mercury ore



銀復生朱

Making cinnabar through sublimation of mercury with sulphur



【原文】

废笔蘸水擦盏，则银自成粉，贴于罐上，其贴口者朱更鲜华。冷定揭出，刮扫取用。其石亭脂沉下罐底，可取再用也。每升水银一斤，得朱十四两，次朱三两五钱，出数借硫质而生。

凡升朱与研朱，功用亦相仿。若皇家、贵家画彩，则即用辰、锦丹砂研成者，不用此朱也。凡朱，文房胶成条块，石研则显。若磨于锡砚之上，则立成皂汁。即漆工以鲜物彩，唯入桐油调则显，入漆亦晦也。凡水银与朱更无他出，其汞海、草汞之说，无端狂妄，饵食者信之。若水银已升朱，则不可复还为汞，所谓造化之巧已尽也。

墨

凡墨，烧烟凝质而为之。取桐油、清油、猪油烟为者，居十之一。取松烟为者，居十之九。凡造贵重墨者，国朝推重徽郡人。或以

【今译】

不断地用废笔蘸冷水滴在铁盘上，则由水银变成的银朱粉末自然会贴在罐壁，贴在罐口部的银朱，更为鲜艳。冷却后将铁盘揭下，就可扫取银朱。沉到罐底的硫黄，还可取出再用。每一斤（十六两）水银，可炼得银朱十四两，次朱三两五钱，多出的重量是从硫黄那里得到的。

人工炼制的银朱，和碾制的天然朱砂，功用差不多。但皇家、贵族作画，则用辰州、锦州的丹砂研成粉，而不用这种银朱。文房用的朱，是用胶做成条块，在石砚上研，可显出朱红色。如果在锡砚上研磨朱，则立刻成为黑汁。漆工用朱的鲜红颜色涂饰漆器时，只有将其与桐油调和，颜色才鲜明。如与漆调和，则颜色发暗。水银和银朱，不能从上述原料以外的物质中取得，因而所谓汞海、草汞之说，都是无端狂妄之论，只有炼丹家和服食所谓长生药的人才相信。水银在炼制成银朱以后，就不可再还原为汞，自然界变化的巧妙，到此已尽了。

墨

墨是由物质燃烧后的烟灰凝聚而成的。用桐油、菜子油、猪油烧成的烟灰制的墨占十分之一，而取松烟造成的墨占十分之九。制



rally stick on the inner wall of the jar and the “mercuric cinnabar” stuck on the jar mouth is much brighter. After cooling, the “mercuric cinnabar” can be swept down and the metal tray can be taken off. The sulphur that sinks to the bottom of the jar can be used again. Every *jin* of mercury can be refined into 14 *liang* of “mercuric cinnabar” and 3.5 *liang* of second-class cinnabar as the extra quantity is realized from the sulphur.

Artificially-refined “mercuric cinnabar” enjoys a similar function to the naturally ground cinnabar. However the royal and noble families use the powder ground from *dan* cinnabar that is originally from Chenzhou and Jinzhou. The cinnabar in this study is made from glue in a bar shape, and the red color can be revealed after being ground on the inkstone. It will be turned into black ink if it is ground on a tin inkstone. Painters can make the color brighter by mixing the cinnabar with tung oil when painting on lacquer. On the other hand, the color will be dark if the lacquer is mixed with oil paint. Mercury and “mercuric cinnabar” cannot be made from other materials. Therefore, the saying that mercury is obtainable from the sea or a certain grass is absolute nonsense which only the alchemists and the gullible believed. When mercury is turned into “mercuric cinnabar”, it can not be returned to mercury any longer, because the wonders of nature are exhausted at this point.

Making Ink

Ink is made from lampblack. One tenth of the ink production is made from tung oil, colza oil, lard, and nine-tenths are made from burning pinewood. The making of precious ink was prevalent in Huizhou in Anhui Province in the Ming Dynasty. Concerning the diffi-



【原文】

载油之艰，遣人僦居荆、襄、辰、沅，就其贱值桐油点烟而归。其墨他日登于纸上，日影横射有红光者，则以紫草汁浸染灯芯而燃炷者也。凡熬油取烟，每油一斤，得上烟一两余。手力捷疾者，一人供事灯盏二百副。若刮取怠缓则烟老，火燃、质料并丧也。其余寻常用墨，则先将松树流去胶香，然后伐木。凡松香有一毫未净尽，其烟造墨终有滓结不解之病。凡松烟流去香，木根凿一小孔，炷灯缓炙，则通身膏液就暖倾流而出也。

凡烧松烟，伐松斩成尺寸，鞠箴为圆屋，如舟中雨篷式，接连十余丈，内外与接口皆以纸及席糊固完成。隔位数节，小孔出烟，其下掩土、砌砖，先为通烟道路。燃薪数日，歇冷入中扫刮。凡烧松烟，放火通烟，自头彻尾。靠尾一二节者为清烟，取入佳墨为料。

【今译】

造贵重的墨，在本朝首推徽州人。他们由于桐油运输困难，便派人去湖北江陵、襄阳与湖南辰溪、沅陵客居，以其廉价桐油就地烧成烟灰带回制墨。用这种墨将字写在纸上，在日光下从侧面看墨色有红光的，是用紫草汁浸灯芯后点灯所烧成的烟造成的。烧桐油取烟时，每一斤油得上等烟灰一两多。手力快的，一人可看管二百盏灯。如果刮烟怠慢，烟烧过头，就会白白浪费灯油和原料。其余寻常用墨，都是由松烟做成的。可先将松树树脂流去，然后伐木。只要松香有一点没有流净，造成的墨最后总有研不开的滓子。流去松香之法，在树根凿一小洞，点灯慢慢焚烧，则整个树干中的松脂因为受热都倾流而出。

烧松烟时，将砍伐下的松木截成一定尺寸，再在地上用竹条做成圆顶棚屋，形状像船上的雨篷，逐节接连成十余丈长。其内外与接口处，均以纸及席子糊固。每隔数节便留一小孔出烟，竹棚下接地处要盖上泥土，里面砌砖时要事先留出烟道。将截短的松木放在棚内燃烧数日，停烧，冷却后进去扫刮松烟。烧松烟时，点燃松木与放烟都是从头节开始，再逐节进行，一直到尾节。尾部的一二节中结成的是清



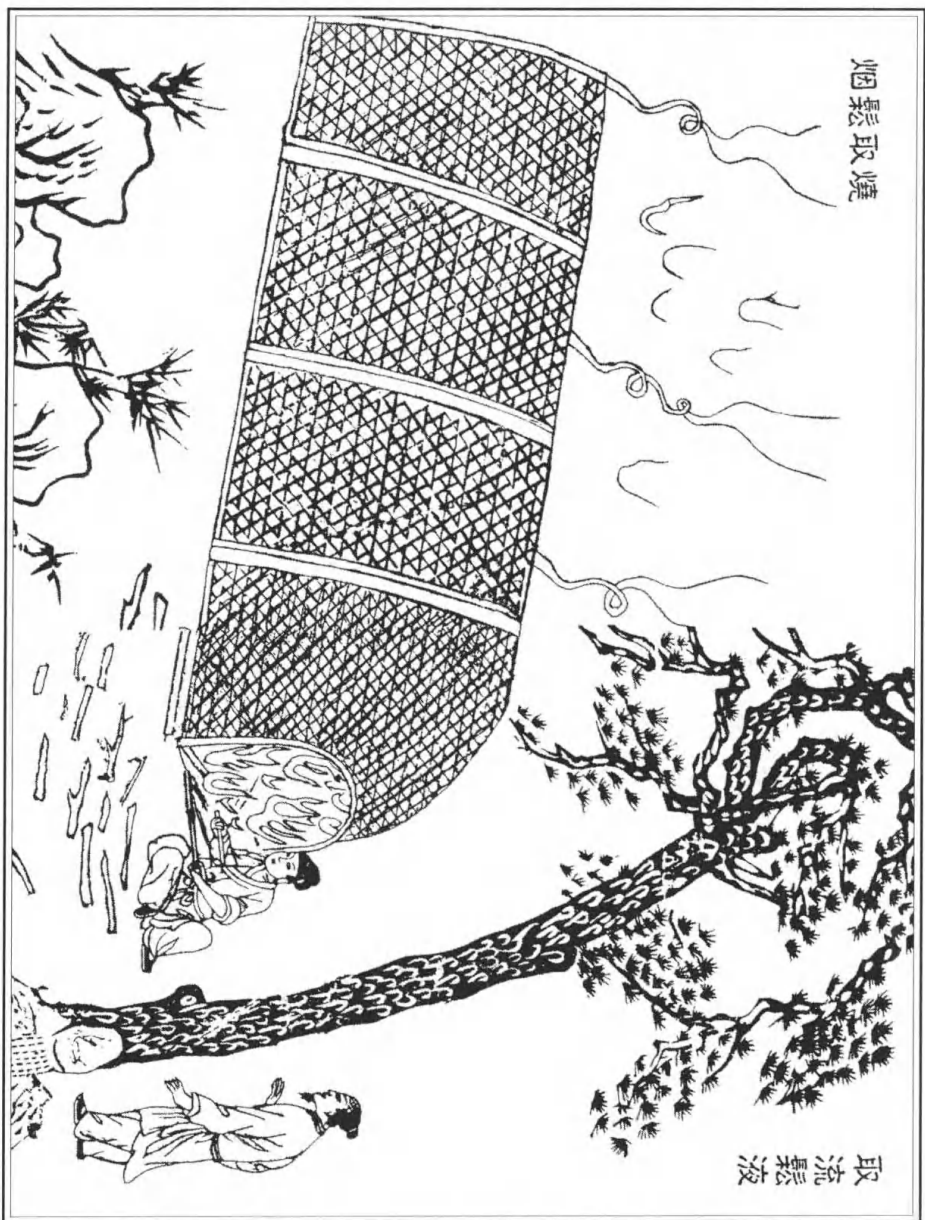
culties of transporting tung oil, people were sent to reside in Jiangling, and Xiangyang in Hubei Province, and Chenxi and Yuanling in Hunan Province where they can buy tung oil at a low price and return with lampblack made on the spot. When used for writing on paper, if the black ink shows a shade of red when it is placed in the slanting sunlight, the lamp-wick used in making lampblack was first soaked in the juice of *Lithospermum officinale* before it was burned. After burning, one *jīn* of tung oil will produce more than one *liang* of good-quality lampblack. Skillful workers can handle two hundred such lamps. If workers are slow in collecting the lampblack, the soot may ignite under the heat of the lamps, resulting in the loss of both the raw materials and the product. The rest of ordinary inks are all made from burning pinewood. Let all the rosin oil of pine trees drain out before felling the trees. To drain the rosin oil, workers make a hole in the root, light a lamp to warm the tree so that all the rosin oil in the tree comes.

The pine tree is felled and sawed into pieces for burning. For making pinewood lampblack, pinewood sticks are used to build a chamber with a round roof made of bamboo sticks, whose appearance is like the rain-shield of a small boat. Then, it is connected one by one in more than 10 *zhang* long. The external and internal surfaces of this chamber and the connecting joints are all securely pasted with paper and matting, but small holes are made at certain distances for emitting smoke. The place connecting the chamber and the earth should be covered with mud. In addition, the holes emitting smoke should be built by bricks built up in layers. The cut pinewood should be burned in the sheds for several days. Then stop burning, sweep and scrape the pine-soot after the pinewood becomes cool. When burning the pine-soot, both lighting the pinewood and emitting smoke must be started in



燃扫清烟

Preparing and collecting oil lampblack



取流松液 燒取松烟
Removing resin from pine tree
Making pinewood lampblack



【原文】

中节者为混烟，取为时墨料。若近头一二节，只刮取为烟子，货卖刷印书文家，仍取研细用之。其余则供漆工、垾土之涂玄者。

凡松烟造墨，入水久浸，以浮沉分精恣。其和胶之后，以槌敲多寡分脆坚。其增入珍料与漱金、衔麝，则松烟、油烟增减听人。其余《墨经》、《墨谱》，博物者自详，此不过粗记质料原因而已。

附：诸色颜料

胡粉：至白色，详《五金》卷。

黄丹：红黄色，详《五金》卷。

靛花：至蓝色，详《彰施》卷。

紫粉：红色，贵重者用胡粉、银朱对和，粗者用染家红花滓汁

【今译】

烟，是制作优质墨的原料。中部各节内为混烟，用以作一般墨料。最前面的一二节内，只能刮取烟子，卖给印刷书籍的坊家，仍要研细使用，其余则供漆工、粉刷工做黑色颜料使用。

将制墨的松烟放入水中久浸，以浮沉情况区分精粗。松烟与胶调和固结后，以捶敲打，根据敲击的多少区分坚脆。至于向墨中加入珍贵材料与烫上金字、填入麝香，则松烟、油烟都可随意加多加少。其他问题均载入《墨经》、《墨谱》，要求得到更多知识的人可自行研究，此处不过粗记原料、制法而已。

附：各种颜料

胡粉：颜色最白，详见《五金》章。

黄丹：红黄色，详见《五金》章。

靛花：深蓝色，详见《染色》章。

紫粉：红色，贵重的用胡粉、银朱对和，一般的用染坊的红花汁做成。



the first shed, and the operation goes on one by one until the last shed. The “pure soot” produced in the last and the second from the last shed is the raw material used to make quality ink. The lampblack gotten from the middle parts is of “mixed” quality and used as ordinary ink. That from the first one or two parts, however, is scraped and sold only as inferior lampblack, it is further pounded and ground by printers and used in printing books. In addition, lacquer workers and plasterers also use the coarse grade as black paint.

Put the pinewood lampblack which has been used for making ink into water and soak it for a long time. The fine pine-soot and coarse pine-soot can be distinguished by the floating condition. Hit the mixed solid pine-soot and glue with a hammer, and the firm and the fragile can be distinguished by the times of hit. As for adding precious materials into ink or gilding golden words or filling with musk, the amount of pine-soot and lampblack can be put at one’s ease. All the other things have been recorded in the *Mojing* (*Ink Classic*), *Mopu* (*Categories of Ink*). Readers who want to know more can refer to them. This record here is just a general description about raw materials and the production method.

Supplement: Varieties of Colors

The color of white lead powder is the whitest. Details are in “Metallurgy”.

Litharge is reddish-yellow. See “Metallurgy” for details.

Indigo is pure blue. Details are in “Dyes”.

Purple powder is red, the valuable type is obtained by mixing equal parts of white lead powder and “mercuric cinnabar”, while that of coarser quality is made with the safflower juice used by the dyeing



【原文】

为之。

大青：至青色，详《珠玉》卷。

铜绿：至绿色，黄铜打成板片，醋涂其上，裹藏糠内，微借暖火气，逐日刮取。

石绿：详《珠玉》卷。

代赭石：殷红色，处处山中有之，以代郡者为最佳。

石黄：中黄色，外紫色，石皮内黄，一名石中黄子。

【今译】

大青：深蓝金，详见《珠玉》章。

铜绿：深绿色，用黄铜打成薄片，涂上醋后藏于米糠内，借其微热，再逐日从铜片上刮取。

石绿：详见《珠玉》章。

代赭石：粉红色，山中处处有之，以山西代县所产的最好。

石黄：中间是黄色，外表是紫色。因为石里面是黄色，又叫石中黄子。



houses.

Deep blue has a dark blue color, see “Pearls and Gems” for details.

Copper green is a deep green color, derived from yellow copper sheets which are painted with vinegar and covered with chaff. The whole thing is slightly heated, and the copper green formed on the metal surface is scraped off every day.

For stone green, see “Pearls and Gems” for details.

Ochre is orange red, found mostly in mountains, but those of Dai County in Shanxi Province are the best in quality.

Orpiment, also called “yellow-stone-kernel,” is found inside rocks that have purple exteriors, but are yellow in the middle.



舟车第十五

【原文】

宋子曰，人群分而物异产，来往贸迁以成宇宙。若各居而老死，何藉有群类哉？人有贵而必出，行畏周行。物有贱而必须，坐穷负贩。四海之内，南资舟而北资车。梯航万国，能使帝京元气充然。何其始造舟车者，不食尸祝之报也？浮海长年，视万顷波如平地，此与列子所谓御泠风者无异。传所称奚仲之流，倘所谓神人者非耶？

舟

凡舟古名百千，今名亦百千。或以形名（如海鳅、江鳊、山梭之

【今译】

宋子说，人群分居各地，物品产于八方，通过相互来往和贸易，构成了社会整体。如果各居一方而老死不相往来，还凭什么来构成人类社会呢？有地位的人总要外出，但怕到处步行；有些物品虽然便宜，却是生活的必需品，由于缺乏而有赖贩运。所有这一切，都得借助于车船等交通工具。在国内，南方要依靠船，北方要依靠车。人们通过车船，翻山越海、贸易各地，而使首都繁荣起来。为什么开始造车船的人，不应当受到崇敬的报答呢？船工长年渡海，视万顷波涛如平地，这简直与所谓列子乘风而行没有什么不同。经传上所说创始车辆的奚仲这类人，如果将其称为神圣的人，有何不可？

船

船的名称，古今都有成百上千种。或者按形状命名（例如海鳅船、



Chapter 15

Boats and Carts

Songzi says that the society is formed and maintained by the mobility of different groups of people, goods and services from different places. Indeed, if people cooped themselves in their own homes, without any new contacts, how could it be possible for the society to come into being? Decent people would always like to travel around, but they might be set back by the long, tiring journey; some cheap goods are necessary for everyday life, but are scarce in the local area and have to be transported from other places. Almost anything from the journey to the transport can hardly be achieved without carts, boats and other means of transport. In our country, people in the South rely heavily on boats and in the North on carts. The capital city enjoys great prosperity from travel and trade between different parts of the country. Why shouldn't the first life who started building boats and carts receive their due respect? In my opinion, the boatman, who has spent many years of his life traveling on the sea and can now take ease on the bumpy waves as if he were on the flat land, bears no difference from the great Taoist Liezi who was said to have the capacity to fly with the wind. By the same token, it is perfectly right to regard people like Xi Zhong—who made the first cart—as great saints.

Boats

Since the advent of boats, there have been tens of hundreds of ways to crown them with different names, including those referring to



【原文】

类)，或以量名，或以质名，不可殚述。游海滨者得见洋船，居江湄者得见漕舫。若局趣山国之中，老死平原之地，所见者一叶扁舟、截流乱筏而已。粗载数舟制度，其余可例推云。

漕 舫

凡京师为军民集区，万国水运以供储，漕舫所由兴也。元朝混一，以燕京为大都。南方运道由苏州刘家港、海门黄连沙开洋，直达天津，制度用遮洋船。永乐间因之，以风涛多险，后改漕运。平江伯陈某，始造平底浅船，则今粮船之制也。

凡船制底为地，枋为宫墙，阴阳竹为覆瓦。伏狮前为阀阅，后为

【今译】

江编船、山梭船之类)，或以载重量命名，或以造船材料命名，总之不胜枚举。去过沿海地区的人可以看到远洋船，住在江河边的人可以看到漕船。如果局限于山区之中，老死于平原之地，则所见到的不过一叶扁舟、渡河筏子而已。下面略载几种船的形式，其余可以类推。

漕 船

京都是军民聚集之地，通过河道将各地物资运来供应首都需要，这就是漕船兴起的原因。元朝统一全国后，以北京为大都，从南方向北的航道，是从苏州刘家港、海门的黄连沙出发，沿海路直达天津，使用的是遮洋船。永乐年间也是这样，后因海上风涛多险，而改为漕运。平江伯陈某始造平底浅船，这就是现在粮船的形式。

漕船的构造，形象地说，船底相当房屋的地面，船枋是四周墙壁，船室上的阴阳竹，则为屋瓦。船头的伏狮可比作房的前门，船尾的伏狮，则为寝室所在。如果说船桅像弓、弩的弓背或弩身，则



their shape (such as “sea eel”, “river flounder”, “mountain shuttle” and so on), volume, and material, to name just a few. Those who have been to coastal areas can see giant ocean-going ships, and those who live by great rivers and canals can see canal boats, but those who are restricted to mountainous areas or spend their whole lives in the plains can see no more than small ferries and rafts. Elaborated below are only several types of boat, since the rest can all be derived from these typical models.

Grain Boats

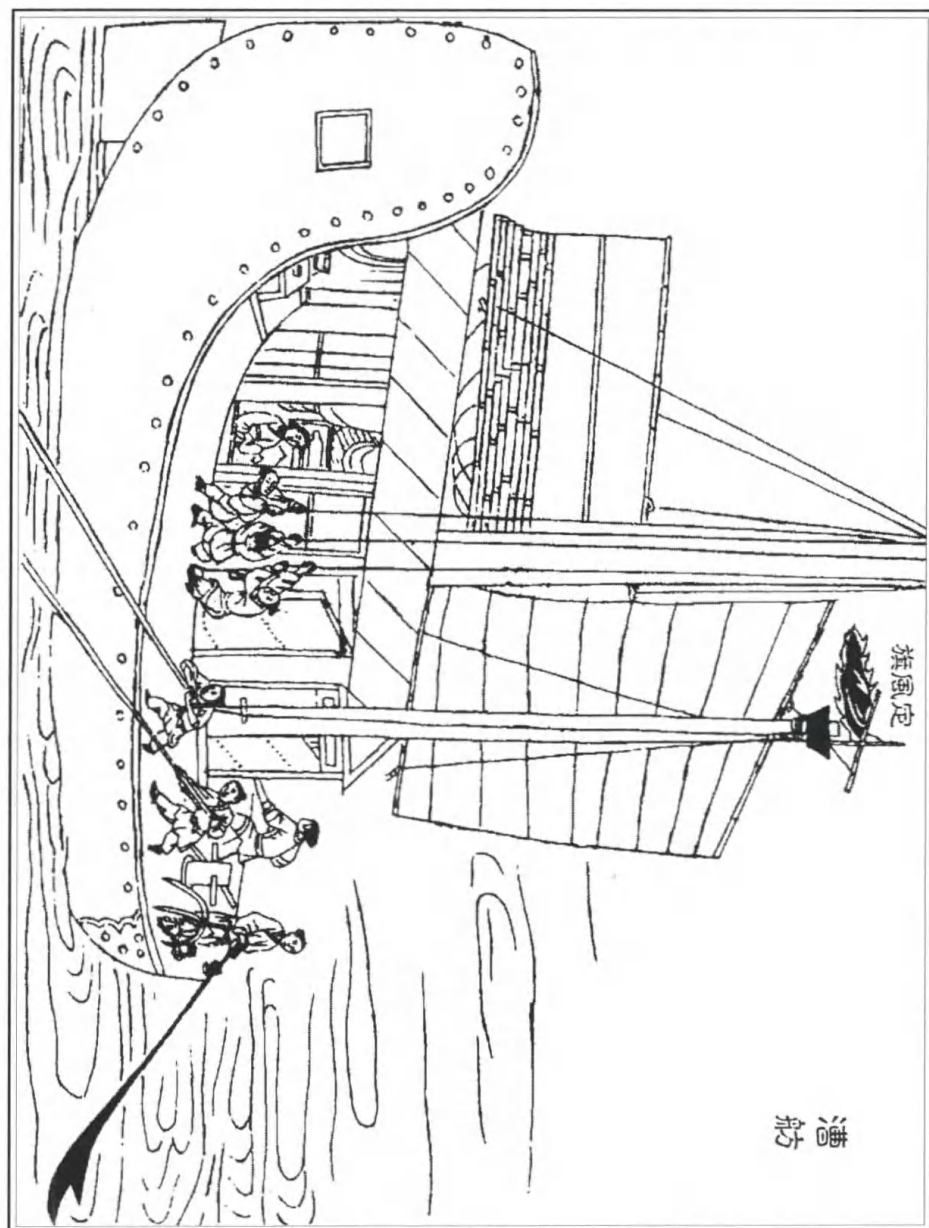
The capital city is the place where people and soldiers congregate, which must be supplied with sufficient goods from different parts of the country. Because of this, the need of grain boats arises. The Yuan Dynasty unified the entire country and chose Beijing as its capital city, then called Dadu. The popular marine route was a south-north path, starting from Liujia Harbour in Suzhou and Huangliansha in Haimen to Tianjin in the north, all using large sea-going vessels. The popularity was still present during the Yongle Reign until it was replaced by river transport, due to various risks on the sea. In 1403, Chen Xuan, a military transportation officer, first commanded 2,000 shallow flat-bottom boats to be built, which became the popular design of today’s grain boats.

The design of grain boats, to apply an easy metaphor, is like this: the bottom of the boat is like the floor of a house, the hull is the walls of a house, the bamboo sections on top of the boat are the tiles of a house; the “crouching lions” in the front of the boat can be compared to the front gate of a house, and that on the stern is like a bedroom. If we compare the mast of the boat to the arc of a bow, the sails are the



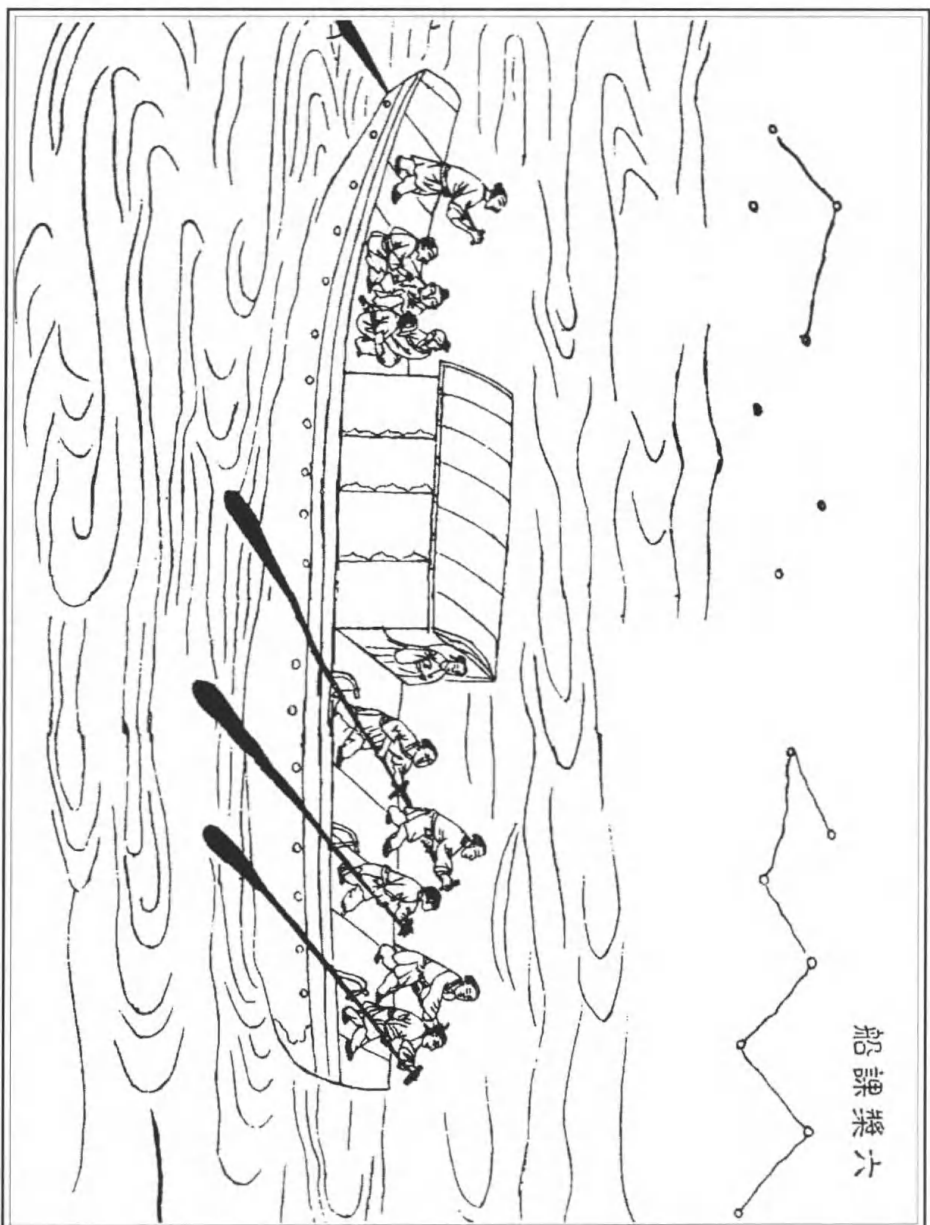
The grain boat

漕舫



海船

定風旗



六桨課船

The six-oar tax boat on the Yangtze and Hanshui river



【原文】

寝堂。桅为弓弩，弦篷为翼。橹为车马，簠纤为履鞋。律索为鹰雕筋骨。招为先锋，舵为指挥主帅，锚为扎军营寨。

粮船初制，底长五丈二尺，其板厚二寸，采巨木，楠为上，栗次之。头长九尺五寸，梢长九尺五寸。底阔九尺五寸，底头阔六尺，底梢阔五尺。头伏狮阔八尺，梢伏狮阔七尺，梁头一十四座。龙口梁阔一丈，深四尺。使风梁阔一丈四尺，深三尺八寸。后断水梁阔九尺，深四尺五寸。两廒共阔七尺六寸。此其初制，载米可近二千石（交兑每只止足五百石）。后运军造者私增身長二丈，首尾阔二尺余，其量可受三千石。而运河闸口原阔一丈二尺，差可渡过。凡今官坐船，其制尽同，第窗户之间宽其出径，加以精工彩饰而已。

凡造船先从底起，底面旁靠墙，上承栈板，下亲地面。隔位列置

【今译】

船帆便是弓弦或弩翼。船橹好比拉车的马，使其行走。则拉船用的纤绳，便好比是走路时穿的鞋子。船帆上的长绳相当鹰、雕的筋骨，船头的大桨是开路先锋，船尾舵则为指挥主帅，而船锚作安营扎寨之用。

粮船最初形制，是船底长五丈二尺，船底板厚二寸，以大木为料，楠木为上，其次是栗木。船头长九尺五寸，船尾长九尺五寸。船底宽九尺五寸，船底前部宽六尺，船尾宽五尺，船头的伏狮宽八尺，船尾的伏狮宽七尺。船上有大梁十四根，接近船头的龙口梁长一丈，高出船底四尺，支撑桅杆的使风梁长一丈四尺，高出船底三尺八寸。船尾部的断水梁长九尺，高出船底四尺五寸。船上的两个粮仓都宽七尺六寸。这都是漕船的最初形制。每船运粮近二千石（但每船交纳五百石即足）。后来军队护送的粮船私自把船身增长约二丈，首尾增宽二尺多，可装载粮食三千石。而运河闸口原宽一丈二尺，这种船勉强可以驶过。现在官吏乘用的客船，其形式与此完全相同，只是楼舱上门窗加大一些，并加以精工彩饰而已。

造船时先从船底造起，船底两边立起船壁，船壁支撑上面的栈板，船壁下面就贴近船底。相隔一定距离在两壁之间横架的木叫梁，



bowstring. The oars are like a horse pulling a cart forward, and the ropes used to pull the boat are like shoes people wear. The long strings on the sail are like the bones and muscles of a hawk. The big oar in the front is the forerunner while the rudder at the stern is the chief commander, and the anchor is used to pitch camp.

The earliest design of the grain boat is like this: the boat bottom is five *zhang* and two *chi* in length, made of planks two *cun* thick. The preferred wood was firstly cedar and secondly chestnut. The front and the stern of the boat were five *chi* and nine *cun* in length. The breadth of the boat bottom was also five *chi* and nine *cun*, that of the front bottom was 6 *chi*, that of the stern bottom was five *chi*. The “crouching lions” in the front were 8 *chi* in width, and those at the stern were 7 *chi* in width. There were 14 big beams on the boat. The one near the front of the boat was named the “dragon’s mouth beam” measuring one *zhang* in width and 4 *chi* above the bottom of the boat; the beam supporting the mast measured 1 *zhang* and 4 *chi*, 3 *chi* and 8 *cun* above the bottom; the beam at the stern measured 9 *chi* in length, 4 *chi* and 5 *cun* above the bottom. With both two granaries having a width of 7 *chi* and 6 *cun*. This is the early design of the grain boats. Each grain boat had a holding capacity of 2,000 *dan* of grains (but only 500 *dan* were delivered to each boat). Later on, the grain boats escorted by the military forces were lengthened without asking for permission by 2 *zhang*, with both the front and the stern being widened more than 2 *chi*, thus obtaining a capacity of 3,000 *dan* of grains. But the canal mouth at that time was only 1 *zhang* and 2 *chi* in width, so this kind of grain boats was just able to pass narrowly. Nowadays, the official passenger boats are exactly the same as that type of boat described above except that they have



【原文】

者曰梁，两旁峻立者曰墙。盖墙巨木曰正枋，枋上曰弦。梁前竖桅位曰锚坛，坛底横木夹桅本者曰地龙。前后维曰伏狮，其下曰拿狮，伏狮下封头木曰连三枋。船头面中缺一方曰水井（其下藏缆索等物），头面眉标树两木以系缆者曰将军柱。船尾下斜上者曰草鞋底，后封头下曰短枋，枋下曰挽脚梁。船梢掌舵所居，其上曰野鸡篷（使风时，一人坐篷巅，收守篷索）。

凡舟身将十丈者，立桅必两。树中桅之位，折中过前二位，头桅又前丈余。粮船中桅，长者以八丈为率，短者缩十分之一二。其本人窗内亦丈余，悬篷之位约五六丈。头桅尺寸则不及中桅之半，篷

【今译】

船底两旁高高直立的叫船墙。构成船壁的巨木叫正枋，上面的枋叫弦。梁前竖立桅杆的部位叫锚坛，锚坛下横架的横木用以夹住桅杆的叫地龙。船前后两头各有一根连接船壁的大横木叫伏狮，伏狮下两边的侧木叫拿狮。伏狮下的封密船头的木叫连三枋。船头甲板中间开一方形洞叫水井（下面装缆绳等物），船头甲板两边立起两根系缆绳的木桩叫将军柱。船尾下面船底两侧由下向上倾斜的船壁叫草鞋底，船尾封尾木下的是短枋，枋下是挽脚梁，船尾掌舵人所在的地方叫野鸡篷（扬帆时，一个坐在篷顶，操纵帆绳）。

船身将近十丈时，必须立两根桅杆。中桅立在船中心向前过两根梁的部位，从中桅离船头方向一丈远之处，再立一船头桅。粮船的中桅桅杆，长的以八丈为准，短的缩小十分之一二。桅杆进入窗



larger windows and colorful decorations.

The building of the boat starts at the bottom, and the walls stand on both sides of the bottom and further support the deck above. The beams are placed at regular intervals, while the part of the boat that rises vertically on both sides is the hull. The large timber that forms the hull is the “principal planking”, on top of which is the gunwale. The spot in front of a beam for positioning the mast is called the “anchor altar”, under it the cross-planks used to secure the mast are called “ground dragons”. There is one big cross-beam at the front and the stern of the boat respectively, called “crouching lions”. The side planks under the “crouching lions” are called “lion holders”; under the bow cross-beam (crouching lion) the wood that closes the front of the boat is called the “wave blocking board”. In the middle of the front deck there is a square hole called “the well” (in which the ropes and cables are stored). Two wooden stakes are erected for winding up the ropes at the forefront deck called capstans. At the stern of the boat, the portion that rises slanting from the bottom upward is called “straw-sandal sole”. The wood that closes the stern end of the boat is the “short plank”, and beneath that is the beam called “stop-foot-beam”. The aft end of the boat contains the helmsman’s quarters, the top of which forms the poop (pheasant’s roost). (Here a man sits on top to manipulate the cordage from the sails when the boat is catching the wind.)

If the length of the boat is near 10 *zhang*, two masts must be erected. The middle mast is located just two beams forward of the middle of the boat, and the foremast should stand at the place 1 *zhang* further ahead. The middle mast of a grain boat can be as long as 8 *zhang* and that for the shorter ones can be reduced by 10 or 20 percent of the length mentioned. The mast inside the windows of the boat is about 1



【原文】

纵横亦不敌三分之一。苏、湖六郡运米，其船多过石瓮桥下，且无江、汉之险，故桅与篷尺寸全杀。若湖广、江西等舟，则过湖冲江，无端风浪，故锚、缆、篷、桅必极尽制度，而后无患。凡风篷尺寸，其则一视全舟横身，过则有患，不及则力软。

凡船篷其质乃析篾成片织就，夹维竹条，逐块折叠，以俟悬挂。粮船中桅篷，合并十人力方克凑顶，头篷则两人带之有余。凡度篷索，先系空中寸圆木关挨于桅巅之上，然后带索腰间，缘木而上，三股交错而度之。凡风篷之力，其末一叶敌本三叶，调匀和畅，顺风则绝顶张篷，行疾奔马。若风力洊至，则以次减下（遇风鼓急不下，以钩搭扯），狂甚则只带一两叶而已。

【今译】

内（舱楼顶至舱底）有一丈多，悬帆的部位约占去五六丈。船头桅杆的长度不及中桅之半，其帆的纵横尺寸，亦不及中桅帆的三分之一。苏州、湖州一带六县运来的米，其粮船大多要过石拱桥，且无长江、汉水之险，故桅与帆尺寸都可缩减。如果驶经湖广、江西等省的船，则过湖穿江时会无故掀起风浪，所以船锚、缆绳、帆、桅都必须严格符合规定尺寸才没有后患。风帆的尺寸要根据全船的宽度决定，尺寸过大则有危险，不足则风力不强。

船帆的材料由破开的竹片编成，用绳编竹片，逐块折叠，以待悬挂。粮船的中桅帆需要十人之力才能升至桅顶，船头帆则两人便足够了。挂帆绳时，先将由一寸粗的中空圆木做成的滑轮系在桅杆顶上，然后将绳索带在腰间攀杆而上，把三股绳交错地穿过滑轴挂绳。风帆顶端一叶所受的风力相当下面的三叶。将风帆调整匀称、顺当，顺风则将帆张到最大限度，则船行速如快马。若风力不断增大，则逐步减少张开的帆叶（遇到大风，帆叶鼓得厉害不能迅速降下时，可用搭钩扯下），风猛时，只张一二叶便可。



zhang in length (from the top to the bottom of it). And the part used for hanging the sail is about 5 to 6 *zhang* long. The front mast is much shorter than that of the middle mast, to half the length of the middle mast. And the size of its sail is less than 1/3 of that of the middle mast sail. The boats coming from the nearby 6 counties in Suzhou and Hangzhou mostly have to go across arched stone bridges and the rivers that are not as dangerous as the Yangtze River or the Hanshui River, so the masts and sails can all be smaller. But those boats going through places like Hubei, Hunan and Jiangxi, where the water is more dangerous, all need to be designed to fulfill strict requirements. The size of the sails is determined by the breadth of the entire boat; it is very dangerous if they are too big; but when they are too small, the boat cannot get enough power from the wind.

The sails are made of crashed bamboo strips, linked by ropes and folded regularly in order to be hung up. The sails of the middle mast are so heavy that it takes ten men to raise them to the top while the front mast sail needs only two men. When hanging the sail ropes, first a pulley made of a one-*cun* hollow log is set on the top of the mast; second, a man climbs along the mast carrying all the ropes around his waist and then puts three skeins of rope through the pulley in a crisscross way. The piece of the sail on top can stand a pressure three times that of a piece in a lower position. The sails need to be adjusted to a proper and balanced state. If sailing is in the direction of the wind, the boat will go very fast like a good horse. If the wind grows, the boat needs less sail to move forward, and when the wind is rather strong, one or two pieces of sail are enough. (If the sails are so blown that they cannot be easily pulled down quickly, a hook can be used to help to pull it down.) If the wind becomes very strong, only one or two sections of the sail need to be extended.



【原文】

凡风从横来，名曰抢风。顺水行舟则挂篷，“之”、“玄”游走，或一抢向东，只寸平过，甚至却退数十丈。未及岸时，捩舵转篷，一抢向西。借贷水力兼带风力轧下，则顷刻十余里。或湖水平而不流者，亦可缓轧。若上水舟，则一步不可行也。凡船性随水，若草从风，故制舵障水，使不定向流，舵板一转，一泓从之。

凡舵尺寸与船腹切齐。若长一寸，则遇浅之时船腹已过，其梢尾舵使胶住，设风狂力劲，则寸木为难不可言。舵短一寸，则转运力怯，回头不捷。凡舵力所障水，相应及船头而止。其腹底之下，俨若一派急顺流，故船头不约而正，其机妙不可言。舵上所操柄，名曰关门棒，欲船北，则南向捩转。欲船南，则北向捩转。船身太

【今译】

借横向吹来的风行船，叫抢风。如果顺水行船，便升帆按“之”或“玄”字形的曲折航线行驶。船抢风向东航行时，如只能平过对岸，甚至后退几十丈，此时趁船还未到达对岸，便立刻转舵，并把帆调转向另一舷上去，即把船抢向西驶。借水力和风力相抵，船沿着斜向前进，一下子便可航行十余里。如在平静而不流动的湖水中行船，亦可借水力、风力缓缓相抵而行。如果逆水行船，又遇横风，就寸步难行了。船顺着水流航行，就像草随风飘动一样，所以要用舵来拦截水，使其不按固定方向流动，因为舵板一转就有一股水流顺从其方向流动。

舵的尺寸下端要与船底取平。如舵长出一寸，当遇到水浅时，船身已过，而船尾的舵却被卡住。若遇猛力狂风，则一寸之木造成的困难就无法形容了。舵若比船底短一寸，则转动力小，船不能很快调转方向。舵拦截水的能力所及，只到船头而止，船底下的水仍俨然是一股顺着水流方向的急流，故船头自然按操纵的正确方向行进，其中的作用妙不可言。舵上的操纵杆叫关门棒，要船头向北，则将其向南转。要使船头向南，则将其向北转。若船身太长，而横向吹来的风又



If the boat goes against an unfavorable wind, it is called tacking. If the boat goes downstream, it is better to hang the sails, and the boat will go in a zigzag way. First the boat may tack to the east, gaining only by inches or even possibly set back a few hundred *chi* before it reaches the bank. It can be changed to go westward by switching the rudder and changing the sails to the other side of the boat. In that way, the power gained from the water stream can counterbalance the obstruction of the wind, and the boat will move in an oblique way and can go very fast—over 10 *li* or so. The counterbalancing effect can also help the boat move forward in a peaceful lake. But if the winds are unfavorable and the boat is going upstream, great difficulties are imposed on its advancement. When the boat goes downstream, it is like the grass moving with the wind. Therefore, it is necessary to control the water with the rudder and prevent it from flowing in a fixed direction, for the turning of the rudder will cause a stream of water to move in its direction.

The bottom of the rudder should be the same size as the bottom of the boat. If the rudder is a bit longer, say, one *cun* extra in length, it is possible that the rudder will stick fast to the bottom of shallows, while the boat itself is able to glide over them; if the wind is strong and contrary, the boat would be in extreme difficulty. If the steer is shorter by even one *cun*, it will not be able to initiate enough turning power for the boat to change its direction. The stretch of water responsive to the rudder extends from the rudder to the bow of the boat: directly under the bottom of the boat the water assumes the nature of a fast headlong current, thus automatically setting the direction of the boat. All this is fantastic beyond description. The handlebar used to steer the rudder is called the tiller. If the boat is to go northward, turn it south, or vice



【原文】

长而风力横劲，舵力不甚应手，则急下一偏披水板，以抵其势。凡舵用直木一根（粮船用者围三尺，长丈余为身），上截衡受棒，下截界开衙口，纳板其中如斧形，铁钉固拴以障水。梢后隆起处，亦名舵楼。

凡铁锚所以沉水系舟。一粮船计用五六锚，最雄者曰看家锚，重五百斤内外，其余头用两枝，梢用两枝。凡中流遇逆风，不可去又不可泊（或业已近岸，其下有石非沙，亦不可泊，唯打锚深处），则下锚沉水底。其所系律，缠绕将军柱上。锚爪一遇泥沙，扣底抓住。十分危急，则下看家锚。系此锚者曰“本身”，盖重言之也。或同行前舟阻滞，恐我舟顺势急去，有撞伤之祸，则急下梢锚提住，使不迅速流行。风息开舟，则以云车绞缆，提锚使上。

凡船板合隙缝，以白麻斫絮为筋，钝凿极入，然后筛过细石灰，和桐油舂杵成团调舱。温、台、闽、广即用蛎灰。凡舟中带篷索，

【今译】

很大，舵力不那么够用，这时要急速放下一块披水板，以抵挡风势。船舵用一根直木作舵身（粮船用的直木围三尺、长一丈多），舵上部横插关门棒，下部锯开接口以装上斧形的舵板，再用铁钉钉固，便可拦截水了。船尾高起的地方，也叫舵楼。

铁锚的作用，是沉在水里将船系住不动。一艘粮船共用五六个铁锚，最大的叫看家锚，重五百斤内外，其余的在船头用两个锚，船尾也用两个。船在中流遇上逆风，既不可进、又不能靠岸停泊时（或业已靠岸，但水底有石头而不是沙土，也不能停泊，只有在水深处抛锚），就要把锚沉于水底。系锚的长绳缠绕在将军柱上，锚爪一遇泥沙便扎底抓住。十分危急时，要下看家锚，系住这个锚的缆索叫“本身”，这是就其重要性而言的。有时本船被同一航向的前面的船阻挡，恐本船顺势急过有撞伤之祸，就要急忙下船尾锚拖住，使之不快速驶过。风平开船，要用云车绞缆绳将锚提上来。

密合船板隙缝，要用剁碎的白麻絮做成麻筋，用钝凿将麻筋塞入隙缝内，然后以筛过的细石灰和桐油捣拌成团，再填充船缝。浙江温州、台州与福建、广东，用蛎灰代替石灰。船上系船帆的绳索用火麻



versa. If the body of the boat is too long, the unfavorable wind is really strong, and the rudder power is not enough to make the boat move, a timely solution is to put down a “water-breaking” board to ward off the wind. The rudder has a big straight trunk for its body (the rudder of the grain boat is over 1 *zhang* long and 3 *chi* in circumference); placed on top of the rudder is the tiller, a joint is sawed at its bottom to connect the axe-shaped rudder board, which, when fastened with iron nails, can perform the function of fending against the water. The high-rising part of the stern is called the aftercastle.

An iron anchor is used to moor the boat. A grain boat needs five or six anchors, the biggest one called the “watchdog anchor” weighing 500 *jin*, two others in the front and still another two at the stern. If the boat encounters unfavorable wind halfway, unable to advance or to get to the bank (or the boat is already near the bank, but the bottom of the river is full of small stones without mud and sand, and the boat can not be moored there, it is necessary to drop the anchor in the deep water). The rope on the anchor is tied to the capstan, and the flukes will get fastened once they reach the mud. If the situation is extremely dangerous, the “watchdog anchor” will be used, whose rope is called “main stake”, which testifies its crucial importance. Sometimes if the boat is getting really close to another boat in front of it going in the same direction and bumps into it, the two stern anchors must be used to stop the boat from moving forward. When the wind dies down and the boat restarts its journey, the anchors will be lifted by a crane.

To caulk the planking of a boat, finely chopped flax is first stuffed into the space between the boards, next a mixture of screened fine lime powder and tung oil is applied to the crevices to complete the caulking. In places like Fujian and Guangdong provinces, Wenzhou and Taizhou



【原文】

以火麻秸绲绞，粗成径寸以外者，即系万钩不绝。若系锚缆，则破析青篾为之。其篾线入釜煮熟，然后绞。拽篾纤亦煮熟篾线绞成，十丈以往，中作圈为接弦，遇阻碍可以掐断。凡竹性直，篾一线千钩。三峡入川上水舟，不用绞篾纤。即破竹阔寸许者，整条以次接长，名曰火杖。盖沿崖石棱如刃，惧破篾易损也。

凡木色桅用端直杉木，长不足则接，其表铁箍逐寸包围。船窗前道，皆当中空阙，以便树桅。凡树中桅，合并数巨舟承载，其末长缆系表而起。梁与枋墙用楠木、楮木、樟木、榆木、槐木。栈板不拘何木。舵杆用榆木、榔木、楮木，关门棒用桐木、榔木，槽用杉木、桧木、楸木。此其大端云。

海 舟

凡海舟，元朝与国初运米者曰遮洋浅船，次者曰钻风船（即海鳅）。所经道里止万里长滩、黑水洋、沙门岛等处，若无大险。与出

【今译】

秸绞，直径达一寸以上的粗绳，即使系住万斤以上的东西也不会断。系锚的缆绳，以破开的青竹做成。先将篾线入锅煮熟，然后再绞。拉船的纤绳也是将篾线煮熟后绞，绳达十丈以上长时，中间做圈当作接环，遇障碍可以掐断。竹性笔直，一条篾线可受千斤。过长江三峡进入四川的水上行船，不用绞的纤绳。而是直接把竹破成一寸多宽的整条竹片，互相连接，名曰火杖。因为沿岸石崖棱如刀刃，怕篾绳容易损坏。

造船用的木料，桅杆用匀称笔直的杉木，长度不够则将杉木连接起来，其外表用铁箍逐寸包紧。船楼前要空出地方，架立桅杆。立中桅时，要拼合几条大船来承载，桅杆一端系以长绳并吊起。船上的梁、枋与船壁，用楠木、楮木、樟木、榆木、槐木，船底和甲板用什么木料都可以，但舵杆则用榆木、榔木、楮木，关门棒用桐木、榔木。船槽用杉木、桧木、楸木。这是用木料的大致情形。

海 船

元朝及本朝初用的运粮海船，叫遮洋浅船，小些的叫钻风船（即海鳅船）。所经过的航道只限于万里长滩、黑水洋及沙门岛等处，似



in Zhejiang Province, oyster shells are pulverized instead of lime. If its diameter is over 1 *cun*, the sail ropes made of marijuana straws can hold a weight of over 10,000 *jin*. The cables and ropes used to tie the anchor are made of boiled thin bamboo strips. The towropes are made the same way. When they are over 10 *zhang*, loops are made on them which can be broken up when necessary. The bamboo is straight in nature and a rope made from it can hold a weight of 1,000 *jin*. If the boat is to go through the three gorges in the Yangtze River and enters Sichuan Province, the towropes are made by linking tall bamboo strips named “fire stick” so that they won’t break easily in dangerous places.

This part is about the types of wood used in boat construction. The masts are made of straight trunks of fir, using one on top of another by fastening them with iron hoops around them every one *cun* outside to achieve the desired height. A certain space must be reserved in the front of the boat for the mast. When the middle mast is being put up, it is brought to the boat on several large vessels, and it is pulled upright by means of a long rope attached to the masthead. The beams, planks, and the boat walls are made of cedar, oak, camphor, elm or locust. Elm or oak is used for the rudder post. There are no special requirements for the bottom and decks. The tiller is made of an evergreen or elm; and the oars of fir, Chinese juniper or catalpa. These are the major varieties of the wood used in constructing a boat.

Sea-going Vessels

The grain boats used during the Yuan Dynasty and early Ming Dynasty are called “wind-penetrating ships” (“sea-going vessels”) if they are smaller. They didn’t go further than Jiangsu and Shandong where the waters are not so deep and there don’t seem to be great dangers.



【原文】

使琉球、日本及商贾爪哇、笃泥等舶制 [比]，工费不及十分之一。凡遮洋运船制，视漕船长一丈六尺，阔二尺五寸，器具皆同。唯舵杆必用铁力木，舱灰用鱼油和桐油，不知何义。凡外国海舶制度，大同小异。闽、广（闽由海澄开洋，广由香山嶼）洋船载竹两破排栅，树于两旁以抵浪。登、莱制度又不然。倭国海舶两旁列橹手拦板抵水，人在其中运力。朝鲜制度又不然。

至其首尾各安罗经盘以定方向，中腰大横梁出头数尺，贯插腰舵，则皆同也。腰舵非与梢舵形同，乃阔板斫成刀形插入水中，亦不捩转，盖夹卫扶倾之义。其上仍横柄拴于梁上，而遇浅则提起。有似乎舵，故名腰舵也。凡海舟以竹筒贮淡水数石，度供舟内人两日之需，遇岛又汲。其何国何岛合用何向，针指示昭然，恐非人力所祖。

【今译】

乎没有大的风险。制造这类船与出使琉球、日本及去爪哇、笃泥等经商所用的船相比，所需人工及成本还不到十分之一。运粮的遮洋船形状比漕船长出一丈六尺、宽出二尺五寸，船上的器具都相同，只是舵杆必须用铁力木，填充船缝要用鱼油和桐油，不知是何道理。外国海船的形状、大小，也与此大同小异。福建、广东海船（福建是从海澄开航，广东从香山嶼开航）把竹破成两半做成排栅，放在船的两旁以抵挡海浪。山东登州、莱州海船的形式，又有所不同。日本国海船两旁排列的橹，起挡水的拦板作用，人在船的两侧用力划橹。朝鲜海船形制又不同。

海船的首尾都各安装罗经盘以定航向，船中间腰部的大横梁伸出船外几尺，以便穿插腰舵。各种海船在这方面都是相同的。腰舵与船尾舵形状不同，是做成刀形的宽板插入水中，并不转动，但起防止船身倾斜的作用。其上面有横柄拴于梁上，遇浅水将其提起，有点儿像舵，故名腰舵。海船上用竹筒贮藏淡水数石，供船内人两日之用，遇到岛屿再汲水补充。船行至某国某岛该用什么航向，罗经盘上的指针都明确指示出来，恐非人力所能及。舵手是全船的核心人物，其见识与魄力简直到了置生死于度外的境地，并不是一时



The costs and human power were less than 1/10 of those going to overseas destinations like Ryukyu Islands, Japan and Indonesia. The sea-going ships are 1 *zhang* and 6 *chi* longer and 2 *chi* and 5 *cun* wider than the grain boats, with the rest parts almost exactly the same except that the rudder post must be made of *Mestua ferra* and that the oil used in the stuffing for the chinks must be fish oil and tung oil. The reasons are unknown. The shape and size of sea-going vessels for overseas voyages are basically the same as above. Those produced in Fujian and Guangdong usually use bamboo boards to ward off waves (In Fujian they start sailing from Haicheng, while in Guangdong they begin sailing from Xiangshan Gorge). Those in Dengzhou and Laizhou in Shandong are slightly different. Japanese sea-going vessels have paddles on each side to keep the water off. The design of Korean sea-going vessels is different.

Compasses are installed in both the front and the stern of sea-going vessels. It is also common for all sea-going vessels to have a big trunk in the middle that is longer than the breadth of the boat so that a waist rudder can be placed there. The waist rudder, different from the stern rudder, is shaped like a knife and put into the water to prevent the vessel from tilting, it does not turn. On top of it there is a handle that can be tied to a beam and hung up when the water is shallow. It looks like a rudder, and hence its name the “waist rudder”. There are bamboo tubes in sea-going vessels to store fresh water supplies for the boat crew for two days and can be replenished once the boat reaches an island. The compasses are quite reliable in telling the right direction for the sea-going vessels, which is definitely beyond the capability of man. The steersman is the most important person of the entire crew, whose experience and resolution, rather than a sudden gathering of



【原文】

舵工一群主佐，直是识力造到死生浑忘地，非鼓勇之谓也。

杂 舟

江汉课船：身甚狭小而长。上列十余仓，每仓容只一人卧息。首尾共桨六把，小桅篷一座。风涛之中恃有多桨挟持。不遇逆风，一昼夜顺水行四百余里，逆水亦行百余里。国朝盐课，淮、扬数颇多，故设此运银，名曰课船。行人欲速者亦买之。其船南自章赣，西自荆襄，达于瓜仪而止。

三吴浪船：凡浙西、平江纵横七百里内，尽是深沟，小水湾环，浪船以万亿计。其舟行人贵贱来往，以代马车、扉履。舟即小者，必造窗牖堂房，质料多用杉木。人物载其中，不可偏重一石，偏即欹侧，故俗名天平船。此舟来往七百里内，或好逸便者径买，北达

【今译】

鼓足勇气能做到的。

杂 船

长江、汉水上的课船：船身狭小而修长，船上有十多个舱，每舱内只容一人卧息。船首及尾部共有六支船桨，另有小桅帆一座。船在风浪中靠这许多桨推动划行。如果不遇逆风，一昼夜可顺水行四百余里，逆水也能行一百多里。本朝盐税以淮安、扬州收缴的数额颇多，故设此船运送税银，名曰课船。旅客要想抢时间办事，也租用此船。其船行路线南自江西的章水、赣水，西自湖北的荆州、襄州，到达江苏的瓜埠、仪真为止。

三吴浪船：在浙江西部到平江府之间纵横七百里内，尽是弯曲的深沟、小河，上面行驶的浪船多得可以十万计。乘船的人不分地位高低而往来于各地，以代替车马或步行。即使是小船，也都在上面建起有窗户的堂房，材料多用杉木。人与货物载入其中，船的两边不可有一石的偏重，否则船便要倾斜，所以也俗称为天平船。这种船往来于七百里水路内，有些图安逸、讨方便的人，租浪船一直向北到达通州和天津卫。沿途只有到镇江要横渡一次长江，待江面



courage, are almost beyond the concern of life and death.

Miscellaneous Boats

The tax boats on the Yangtze River and the Hanshui River. Long and slender as these boats are, there are a dozen cabins on board, each big enough for one person to sit and sleep in. There is a mast and six oars altogether at the front and the stern. The boat has to rely on the six oars to advance in the wind. If the winds are favorable, the boat can go downstream over 400 *li* within 24 hours, and over 100 *li* if it is going upstream. As a large proportion of the government's salt revenue is collected from the Huai'an and Yangzhou regions in Jiangsu Province, the tax boats are constructed to transport silver, hence these boats are called "tax boats". Travelers on business trips who wish to save time also hire these boats for traveling. These boats sail to Zhangshui and Ganshui in Jiangxi Province in the south, to Jingzhou and Xiangzhou in Hubei Province in the west, and to Guabu and Yizhen in Jiangsu Province in the east.

The wave-riding boats in Jiangsu Province. From the western part of Zhejiang Province to Pingjiang Prefecture, there is a total area of 700 square *li*, where there are numerous winding streams and channels. Thousands of wave-riding boats are going back and forth on these waterways. Boat passengers, whether rich or poor, travel on these boats instead of using carts, horses or going on foot. Even the smaller boats have a main hall built of fir in the middle. With passengers and goods on board, these boats must be kept in good balance, otherwise they will overturn. These boats are consequently called "balance boats". These boats travel on the waterways of 700 *li*, so for convenience and comfort, some travelers hire such boats to go up north all the way to Tongzhou



【原文】

通、津。只有镇江一横渡，俟风静涉过。又渡青江浦，溯黄河浅水二百里，则入闸河安稳路矣。至长江上流风浪，则没世避而不经也。浪船行力在梢后，巨橹一枝，两三人推轧前走，或持簷纤。至于风篷，则小席如掌，所不恃也。

浙西西安船：浙西自常山至钱塘八百里，水径入海，不通他道，故此舟自常山、开化、遂安等小河起，钱塘而止，更无他涉。舟制簷篷如卷瓮为上盖。缝布为帆，高可二丈许，绵索张带。初为布帆者，原因钱塘有潮涌，急时易于收下。此亦未然，其费似侈于篾席，总不可晓。

福建清流、梢篷船：其船自光泽、崇安两小河起，达于福州洪塘而止，其下水道皆海矣。清流船以载货物、商客。梢篷船大，差可

【今译】

风止时过江。再渡过运河上的清江浦，沿黄河的浅水逆行二百里，进入大运河的闸口，以后便是安稳的航路了。长江上游因风浪太大，浪船是永世不能去的。此船的推进力全在船尾，有一支巨橹，由二三人摇动使船前进，或靠纤绳在岸上牵拉而走。至于风帆，不过是如掌的小席，船的行走可以完全不依靠它。

浙西西安船：浙江西部从常山至杭州府的钱塘，钱塘江流经八百里直接入海，不通别的航道。所以这种浙西西安船从常山、开化、遂安等处的小河航起，至钱塘而止，并无别的航道。这种船用簷竹编成的瓮状圆拱形的棚作为顶盖，缝布作帆，高约二丈，以棉索张帆。当初用布帆是因为钱塘有海潮涌来，紧急时可很容易地收下。但也未必尽然，因其费用似比竹席要高，总之很难理解为何用布帆。

福建清流船、梢篷船：从光泽、崇安两县的小河开船，到达福州洪塘而止，再往下的水道就是海路了。清流船用以运载货物、客商。而梢篷船形状大，正好可供人坐卧，都是富贵人家用的。这类船都是



and Tianjin. On such a journey by water, the boats only has to pass the Yangtze River in Zhenjiang once when the wind is calm. Next they pass the intersection of Qingjiangpu at the Grand Canal between Beijing and Hangzhou and go up the Yellow River for 200 *li* in shallow water. The rest of the journey will be safe with no obstacles. Due to the turbulent water in the upper reaches of the Yangtze River, they never sail there. The forward power of the wave-riding boats is provided mainly by a scull located at the stern and worked by two or three men at a time, or sometimes they are pulled along by trackers with ropes. The boats never depend on sails to go forward.

The Xi'an boats in western Zhejiang Province. The Qiantangjiang River is located between Changshan and Hangzhou in western Zhejiang Province. It is 800 *li* long and flows directly into the sea. So the Xi'an boats (named after the Xi'an County in eastern Zhejiang Province) all sail from the streams in Changshan, Kaihua and Sui'an and go along the Qiantangjiang River, without using other inland waterways. The cabins of these boats are constructed of woven straw matting in the shape of water jars. They carry cloth sails about 20 *zhang* high, which are secured to the boats with cotton ropes. The cloth sails are used because they can be taken down easily when the powerful tides of the Qiantangjiang River estuary are reached. Cloth sails cost more than those made of woven bamboo bark, so it is not clear why cloth sails are used.

The Qingliu boats and the Shaopeng boats in Fujian Province. These boats start sailing on the streams in Guangze and Chong'an counties and arrive at the Hongtang in Fuzhou in Fujian Province, and go no further. The Qingliu boats are used to transport merchants and goods. The Shaopeng boats are larger ones with living quarters, so that



【原文】

坐卧，官贵家属用之。其船皆以杉木为地。滩石甚险，破损者其常，遇损则急舣向岸，搬物掩塞。船梢径不用舵，船首列一巨招，捩头使转。每帮五只方行，经一险滩，则四舟之人皆从尾后曳缆，以缓其趋势。长年即寒冬不裹足，以便频濡。风篷竟悬不用云。

四川八橹等船：凡川水源通江、汉，然川船达荆州而止，此下则更舟矣。逆行而上，自夷陵入峡，挽纤者以巨竹破为四片或六片，麻绳约接，名曰火杖。舟中鸣鼓若竞渡，挽人从山石间闻鼓声而咸力。中夏至中秋，川水封峡，则断绝行舟数月。过此消退，方通往来。其新滩等数极险处，人与货尽盘岸行半里许，只余空舟上下。其舟制，腹圆而首尾尖狭，所以避滩浪云。

【今译】

以杉木做船底。沿途浅滩岩石甚险，常使船破损，遇到船破便急忙靠岸，搬出货物并堵塞漏洞。船尾不使用舵，而是在船首安一巨桨，调转船头使之改变方向。每次都要有五只船结队航行，经过险滩则四只船的人都用绳索拉前一船的船尾，以减慢速度。船工成年即使是寒冬也不穿鞋，以便涉水。其风帆竟是挂而不用的。

四川八桨船等：四川水源本来与长江、汉水相通，然而从四川来的船，行至荆州便止，再往下就要换船。要从相反方向逆水去四川，从夷陵进入三峡，要靠拉纤，拉纤的人将巨竹破成四片或六片，用麻绳接长，名曰火杖。船中鸣鼓有如赛船，拉纤的人在岸边山石上听到鼓声而一齐用力。中夏至中秋四川涨水封峡，便会有数月停止行船。此后江水消退，才通往来。在新滩江面上有几处极其危险，这时人和货物都要在岸上行半里路，只剩下空船在江里行走。四川八桨船的形式是中间圆而首尾尖，为了防避滩浪。



the rich can sit or sleep during their journey. The bottoms of the boats are constructed of fir. The shallow waterways have rocks underneath which frequently damage the boats. When that happens, the boats are immediately steered ashore, unloaded, and repaired. Instead of the stern rudder, these boats are equipped with a huge steering paddle at the bow. The boats are steered by turning the paddle at the head. The boats sail in flotillas of five. When passing dangerous shoal waters, the speed of the boat is reduced by having the four other boats line up behind the lead boat and pulling each other back with ropes. All the year round the adult boatmen are bare-footed even in deep winter for the convenience of crossing water. The sail is hung but not used.

The eight-scuttle and other boats in Sichuan Province. The waterways are connected with the Yangtze River and the Hanshui River, yet boats coming from Sichuan go downstream no further than Jingzhou, and if people wish to go further, they have to change boats. Boats going upstream on the Yangtze River to Sichuan enter the Three Gorges at Yiling. The trackers split giant bamboos vertically into four or six sections and tie them together with hemp ropes (called "fire sticks"). The men in the boats beat drums as though for a race, so that the trackers, standing on the rocks along the shore together, pull the boats forward to the beat of the drums. Between mid-summer and mid-autumn, high water seals off the Three Gorges and for several months boat traffic is suspended until the water has fallen. At Xintan there are some very dangerous spots in the waterway, so the men and goods are all removed from the boats and portage is used for a distance of about half a *li*. The empty boats are left to ride out the turbulent waters. These boats are constructed with a round bottom and a pointed narrow bow and stern, designed to cope with the shoal waters.



【原文】

黄河满篷梢：其船自河入淮，自淮溯汴。舟之质用楠木，工价颇优。大小不等，巨者载三千石，小者五百石。下水则首颈之际，横压一梁，巨橹两枝，两旁推轧而下。锚、缆、簠、篷制与江汉相仿云。

广东黑楼船、盐船：北自南雄，南达会省。下此惠潮通漳泉，则由海汊乘海舟矣。黑楼船为官贵所乘，盐船以载货物。舟制两旁可行走。风帆编蒲为之，不挂独竿桅，双柱悬帆，不若中原随转。逆流凭借纤力，则与各省直同功云。

黄河秦船：造作多出韩城。巨者载石数万钧，顺流而下，供用淮、徐地面。舟制首尾方阔均等。仓梁平下，不甚隆起。急流顺下，

【今译】

黄河满篷船：从黄河进入淮河，再从淮河逆行至河南汴水时用这种船。造船材料用楠木，工价颇贵。大小不等，大船载三千石，小的载五百石。顺水航行时，在船头与船身之间横架一梁，梁上安两个巨橹，人在船两边摇动此橹使船行进。其船锚、缆绳、纤绳及帆等形式，均与长江、汉水上运行的船相同。

广东黑楼船、盐船：北从广东南雄航行，南达省会广州。再往下则从惠州、潮州通往福建漳州、泉州时，便要在海道出海口乘海船了。黑楼船是达官贵人所乘，盐船则运载货物。船的两侧有通道可以行人。其风帆则以蒲编织成，船上不立独桅杆，而是以两根立柱悬帆，不像中原的船帆那样可以转动。逆流航行要靠纤绳牵拉，这是与其余各省一样的。

黄河秦船：其制造多出于陕西韩城。大的载石数万斤顺流而下，供淮安、徐州一带使用。这种船的形式是首尾宽度相等，船舱和梁都较低平而不甚隆起。船顺黄河急流而下，用两旁巨橹摇动使之推



The full-sail boats on the Yellow River. These boats are used to sail from the Yellow River to the Huaihe River, and also go upstream on the Huaihe River to Bianshui River in Henan Province. The boats are expensively made of cedar wood. They have different sizes, with the larger ones having a capacity of 3,000 *dan* and the smaller ones having a capacity of 500 *dan*. When a boat is sailing downstream, a beam is laid across the foredeck, while the boats are propelled forward by two large sculls fixed on both sides of the boats. The anchor chains, rigging and sails carried by these boats are the same as those of the boats on the Yangtze River and the Hanshui River.

The black castle and the salt boats in Guangdong Province. These boats sail between Nanxiong in the north and Guangzhou, capital city of Guangdong Province. Going further to Zhangzhou and Quanzhou in Fujian Province by way of Huizhou and Chaozhou, sea-going crafts are used. The black castle boats are used by high-ranking officials and noble families, whereas the salt boats are used to transport merchandise. There are passageways built on both sides of the bulwark. The sails are made of woven reed mats, which are hung on two posts instead of on the mast. The sails hung in this manner are less maneuverable than those of the boats in Central Plains. When going upstream, the boats rely on tracking, which is the same as the practice in other provinces.

The Shaanxi boats on the Yellow River. These boats are constructed mainly in Hancheng of Shaanxi Province. The larger ones can carry tens of thousands of *jin* of stones down the Yellow River to supply the needs in the Huai'an and Xuzhou regions in northern Jiangsu Province. The boats are built with the bow and the stern equal in width, and the cabins are low-lying. When going down the Yellow River in a swift current, without depending on the wind, two huge sculls



【原文】

巨橹两旁夹推。来往不凭风力，归舟挽纤多至二十余人，甚有弃舟空返者。

车

凡车利行平地，古者秦、晋、燕、齐之交，列国战争必用车，故“千乘”、“万乘”之号，起自战国。楚、汉血争而后日辟。南方则水战用舟，陆战用步、马。北膺胡虏，交使铁骑，战车遂无所用之。但今服马驾车以运重载，则今骡车即同彼时战车之义也。

凡骡车之制，有四轮者，有双轮者，其上承载支架，皆从轴上穿斗而起。四轮者前后各横轴一根，轴上短柱起架直梁，梁上载箱。马止脱驾之时，其上平整，如居屋安稳之象。若两轮者，马驾行时，马曳其前，则箱地平正。脱马之时，则以短木从地支撑而住，不然则欹卸也。

【今译】

进，来往都不靠风力。逆水返航时，拉纤的多至二十余人，因此甚至有连船也不要而空手返回的。

车

车利于平地运行。战国时代，秦、晋、燕、齐各诸侯国交战，必用车进行，因此“千乘”、“万乘”之国的说法，是从战国时开始的。自秦末项羽、刘邦激战后，使用战车便日渐减少。南方水战用船，陆战则用步兵、骑兵。北方与游牧民族作战，双方互相多使用铁骑，战车便用不上了。如今只是取马驾车以运载重物，则今日骡马车与昔日战车的构造原理，应当是相同的。

骡马车的形制有四轮的，有双轮的，车上承载的支架，皆从轴上穿孔而接起。四轮骡马车前后各有一根横轴，轴上的短柱上边架设纵梁，梁上装车箱。当骡马停止，从车上卸下时，车身端平，像房屋那样安稳。如果双轮车驾马行走时，有马在前面拉车，则车箱亦平稳。卸马时则以短木支撑于车前，不然，卸马后便将车身前部倒放在地上。



are used to propel the boats. When traveling upstream on the return voyage, trackers are used, and sometimes over 20 men pull the boats at a time. There are occasions when the boats are abandoned and the men return without them.

Carts

Carts or carriages are best used on level terrains. During the Warring States Period, chariots were used when the states of Qin, Jin, Yan and Qi engaged in warfare. Hence there were such designations as a "one-thousand-chariot state" or a "ten-thousand-chariot state" beginning from then on. After the bloody battle between the state of Chu led by Xiang Yu and the state of Han led by Liu Bang, use of chariots decreased. In the south, boats are used in marine battles, while infantry and horses are used in land battles. In the north, armored cavalry are employed in the fights with the nomadic tribes, thus the chariots are not used. Nowadays the horse-drawn carts are used to transport freight, and the mule-drawn or horse-drawn carts are constructed in the same way as chariots in the past.

The mule-drawn and horse-drawn carts are built either with two or four wheels, and the axletree is the base on which the superstructure of the cart is constructed. On the four-wheel cart, there is an axletree both fore and aft, on which rest short posts that support straight beams and on the beams rest the body of the cart. When the cart is not in motion and the horses are un-harnessed, the cart is as level and secure as one's own living room. In contrast, the body of the two-wheeled cart remains level only while it is drawn by the horse or mule. When the horses are unhitched, the cart must be propped up with posts, otherwise the front of the cart will touch the ground.



【原文】

凡车轮，一曰轅（俗名车陀）。其大车中轂（俗名车脑）长一尺五寸，所谓外受辐、中贯轴者。辐计三十片，其内插轂，其外接辅。车轮之中，内集轮、外接辘，圆转一圈者是曰辅也。辘际尽头则曰轮轅也。凡大车脱时，则诸物星散收藏。驾则先上两轴，然后以次间架。凡轼、衡、軫、輶，皆从轴上受基也。

凡四轮大车量可载五十石，骡马多者或十二挂，或十挂，少亦八挂。执鞭掌御者居箱之中，立足高处。前马分为两班（战车四马一班，分驂、服）。纠黄麻为长索，分系马项，后套总结，收入衡内两旁。掌御者手执长鞭，鞭以麻为绳，长七尺许，竿身亦相等。察视不力者，鞭及其身。箱内用二人踹绳，须识马性与索性者为之。马行太紧，则急起踹绳。否则翻车之祸从此起也。凡车行时，遇前途行人应避者，则掌御者急以声呼，则群马皆止。凡马索总系透衡入

【今译】

车轮又名叫轅（俗名车陀）。大车车轮中心的轂（俗名车脑）长一尺五寸。所谓轂，是其外边承受辐、当中插入车轴的部件。每个轮中的辐共有三十根，这些辐的内端插入轂中，外端都与辅相连接。车轮中所谓的辅，是其内侧集中了辐、外侧与辘（轮圈）相连的圆图形部件。轮圈的最外边叫轮轅。大车不用时，则将一些大部件拆散收藏。驾车时先装上两个车轴，然后依次装其余部件。因为轼、衡、軫、輶等部件都是从轴上安装起来的。

四轮大车可承载五十石重，驾车的骡马多的有十二挂或十挂，少的也有八挂。执鞭驾车者站在车箱里居高临下。车前的马分为两组（战车以四马为一组，最外边的两匹叫驂，里面的两匹叫服）。将黄色的大麻绞成长绳系在马颈的后部，套马的绳在后面合拢并收入到衡的两旁。赶车人手执长鞭驱车，鞭用麻做成绳，长七尺，鞭杆也七尺长。察看有的马不用力时，便鞭打其身。车箱内有熟悉马的习性和控制绳索的二人踹绳。如果马跑得太快，要赶紧踩住缰绳，否则有翻车之祸。车走时遇有前面行人应躲避，赶车人要急速发出吆喝声，则群马皆停。马的缰绳要收拢，穿过车轅横木入车厢之处，都用牛皮条绑

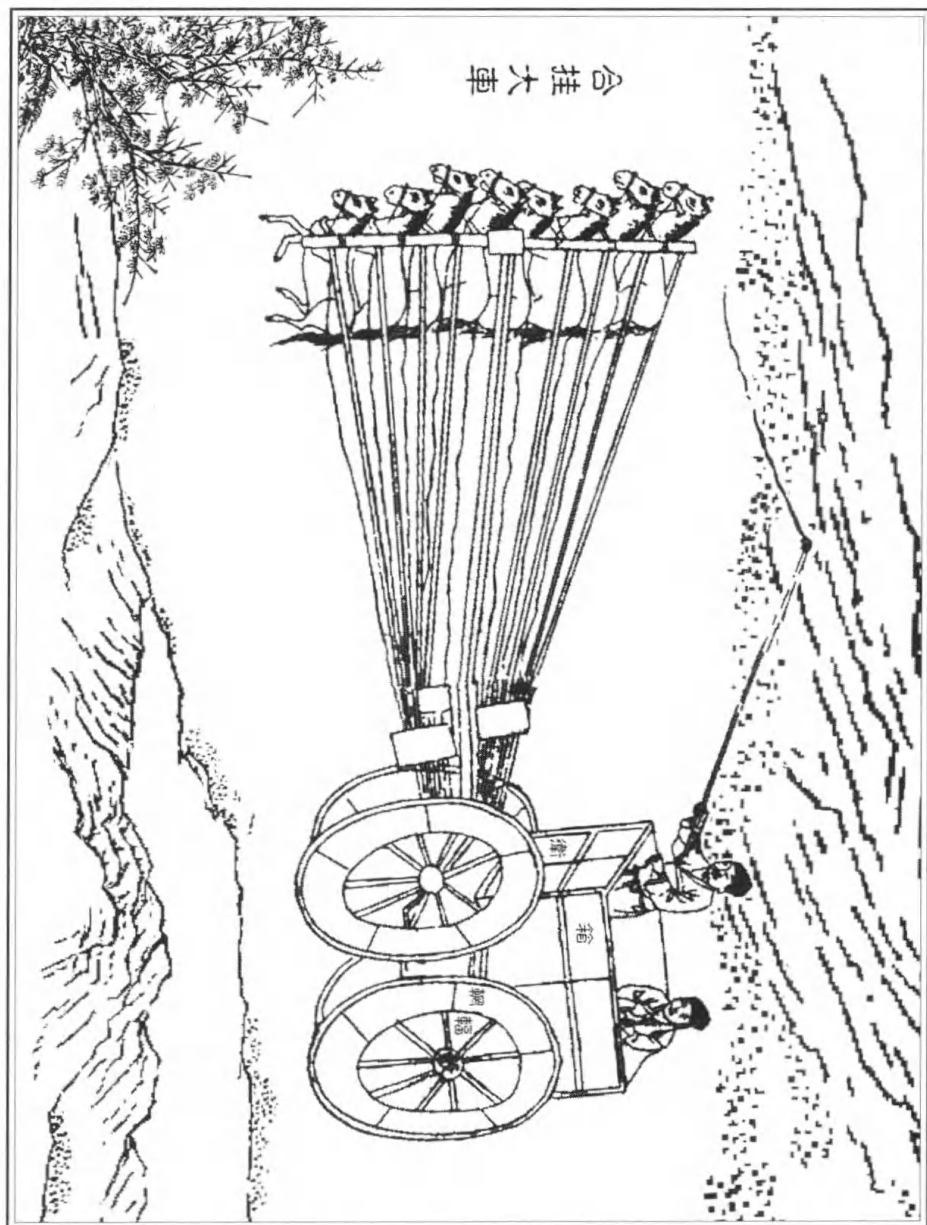


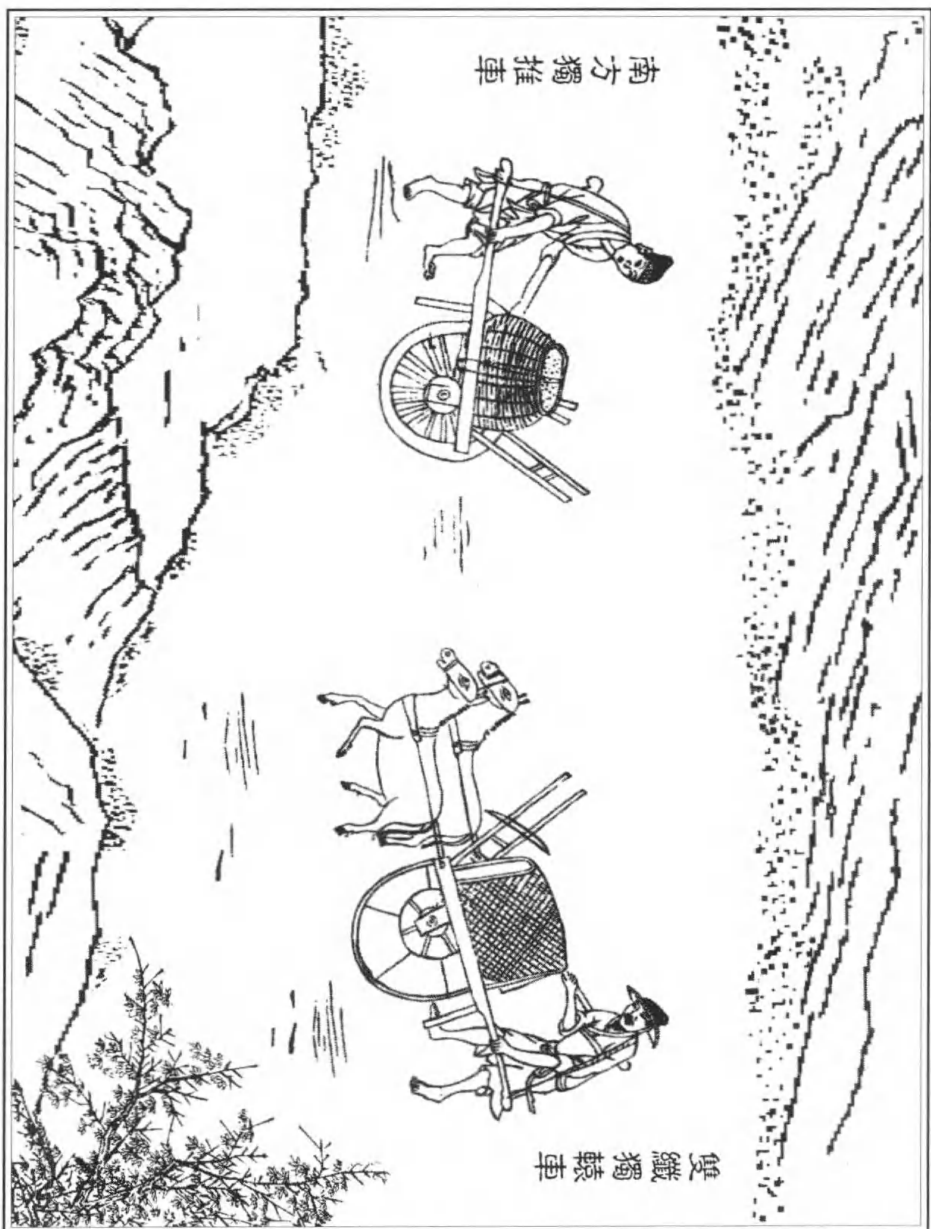
The wheels of the cart are called “yuan” (called the steer of the cart). The hub of a larger cart in the center of a wheel (also called the brain of the cart) measures one and a half *chi* in diameter and supports the spokes all round itself while allowing the axle to come through the center. There are spokes on each wheel. The inner end of each spoke is attached to the hub and the outer end to the interior rim. In a wheel, the part which inwardly holds the wheel together and connects outwardly to the felloe, making a complete circle, is known as the interior rim. The “lun yuan”, or “shaft” of a wheel is where the felloe or exterior rim terminates. When the cart is not in use, its composite parts are taken apart for storage. To assemble a cart, first mount the two axletrees, and then put the other parts together step by step.

The four-wheeled cart has a capacity for carrying 50 *dan* of freight. As many as 10 or 12 horses or mules are put together to form a team to pull the cart. The driver stands on an elevated platform in the front part of the cart. The horses or mules are harnessed to form two groups (each group contains four horses, to pull a war chariot, and called the outer horses and the inner horses). A long hemp rope is attached to the neck of each horse or mule, tied together and passed inside the front cross-board, and then fastened to the sides of the cart. The driver wields a long hemp whip of 7 *chi* with a handle of equal length. If any animal is not pulling its full weight, the driver whips the animal. There are two other persons in the cart who are familiar with the nature of horses and mules and who are responsible for pulling the ropes. They step on the ropes to slow the cart down if the horses or mules are trotting too fast, otherwise the cart may overturn and crash. If it is necessary to avoid hurting pedestrians walking ahead of the cart, the driver immediately calls out a command to stop all the horses or mules. All the ropes are



合挂大车
The four-wheeled cart drawn by eight mules or horses





雙纖獨轆車 南方獨推車

The single-wheeled cart drawn by two mules or horses
The single-wheeled cart pushed by one person in South China



【原文】

箱处，皆以牛皮束缚。《诗经》所谓“胁驱”是也。

凡大车饲马，不入肆舍。车上载有柳盘，解索而野食之。乘车人上下皆缘小梯。凡遇桥梁中高边下者，则十马之中，择一最有力者，系于车后。当其下坂，则九马从前缓曳，一马从后竭力抓住，以杀其驰趋之势，不然则险道也。凡大车行程，遇河亦止，遇山亦止，遇曲径小道亦止。徐、兖、汴梁之交，或达三百里者，无水之国所以济舟楫之穷也。

凡车质，唯先择长者为轴，短者为毂，其木以槐、枣、檀、榆为上。檀质太久劳则发烧，有慎用者，合抱枣、槐，其至美也。其余轸、衡、箱、輶，则诸木可为耳。此外，牛车以载刍粮，最盛晋地。

【今译】

住。这就是《诗经》中所谓的“胁驱”。

大车行至中途要喂马时，不必将马赶至马棚，因为车上带的柳条筐内装着饲料，将缰绳解开后可以就地喂马。乘车人上下都要蹬小梯子。车子经坡度较大的桥而要下桥时，要在十匹马中选一匹最有力的在车后。当车下坡时，九匹马在前面缓慢拉车，一匹马在后边竭力把车拖住，以减少车快行的趋势，不然就危险了。大车行进时，遇到河要停，遇到山也要停，遇到弯曲小道更要停。江苏徐州、山东兖州、河南汴梁境内车行可达三百里，在没有江河的地区，可弥补缺乏水运的不足。

做车的木材，首先选长木作轴，短的作毂，以槐木、枣木、檀木、榆木为上料。檀木使用时间长，会因摩擦而发热，细心的人用合抱的枣木、槐木，这是最好的做车轴的木料。其余像轸、衡、箱、輶



passed through the front cross-board, tied with ox-hide in a bundle and finally get to the center of the cart. This was termed a “driving aid” in *The Book of Poetry*.

When horses or mules are to be fed on the journey, they are not taken to a stable, instead they are given their feed in the open air, since willow-woven trays with feed are brought along on the cart. Persons embark and disembark from the cart by means of a small ladder. When crossing a highly arched bridge, the strongest horse or mule in the team (e.g. of ten) is chosen and tied to the rear of the cart. When the cart goes down the slope, the rest of the horses or mules in front are made to proceed slowly, while the horse or mule at the rear is to pull the cart backward to reduce the speed of the cart. Otherwise, the cart is endangered. If the cart encounters either a river, a mountain or a narrow winding path, it has to stop. In such regions as Xuzhou in Jiangsu Province, Yanzhou in Shandong Province and Bianliang in Henan Province, the route of carts may reach an extent of 300 *li*, which compensate for the want of transportation by boats in regions which have no waterways.

In constructing the carts, long pieces of wood are chosen for axles and short ones for the hub. The best types of wood for these purposes are the locust, jujube, sandalwood or elm. Sandalwood, tough, durable and long-lasting, tends to become hot after long and continuous use in motion, therefore, the best material is either jujube or locust trunk which is so thick that a man has to use both arms to hold it. The other parts of the cart, the front and rear cross-boards, the body and the yoke of the cart, can be made of any kind of wood. Another type of cart is the ox-drawn cart, which is widely used for transporting grain and plant stalks in Shanxi Province. Where the road becomes narrow, the ox will



【原文】

路逢隘道，则牛颈系巨铃，名曰“报君知”，犹之骡车群马尽系铃声也。

又北方独辕车，人推其后，驴曳其前，行人不耐骑坐者，则雇觅之。鞠席其上以蔽风日。人必两旁对坐，否则欹倒。此车北上长安、济宁，径达帝京。不载人者，载货约重四五石而止。其驾牛为轿车者，独盛中州。两旁双轮，中穿一轴，其分寸平如水。横架短衡，列轿其上，人可安坐，脱驾不欹。其南方独轮推车，则一人之力是视。容载两石，遇坎即止，最远者止达百里而已。其余难以枚述。但生于南方者不见大车，老于北方者不见巨舰，故粗载之。

【今译】

等部件，用各种木料都可以做成。此外，用牛车运载粮草在山西最盛行，半路遇到狭路，则在牛颈上系一巨铃，名曰“报君知”，就像骡车的马都系上铃一样。

北方还有独轮车，由人在后面推，驴在前面拉，不耐长期骑马的人，常租用这种车。车上有半圆形的席棚，以蔽风吹日晒。人必须在两侧对坐，否则车会倾倒。这种车在北方从陕西长安、山东济宁出发，可直接到达北京。不载人时，车上约可载货四五石重。还有一种牛拉的轿车，只盛行于河南。这种车两旁有双轮，中间穿一车轴，必须十分水平。在车辕上横架一些短木，把轿装在上面，人可以安稳坐在轿内，卸牛后，车也不倾倒。南方的独轮手推车，用一人之力即可推走。可以载重二石，但遇到坎坷地段便不能走，最远时只到百里而已。其余各种车难以枚举。只因出生于南方的人没见过大车，而老死于北方的人又没见过大船，故在这里作一个简略的介绍。



shake the bell hanging from his neck to alert the cart driver, hence the bell is called “herald bell”, which serves the same purpose as the bell hung from horse or mule neck.

In North China, there is also the single-wheeled cart pushed by a man from the rear and drawn at the same time by a donkey in front. Travellers who do not wish to ride on horseback often hire such a cart for their journeys. A semi-circle awning is erected overhead to serve as a cover against the wind and sunlight. The passengers must sit face to face, one on each side of the wheel to balance the cart, otherwise the cart will tip over. In North China, these carts start their journeys from Chang'an in Shaanxi Province, and Jining in Shandong Province and go all the way to Beijing. When the carts do not carry passengers, they can be used to transport merchandise, and each cart can carry 4 or 5 *dan* of merchandise. Ox-drawn enclosed wagons are used only in Henan Province. There are two wheels, which are connected to the cart by an axletree. This axletree is level and keeps the cart in perfect balance. The boards are laid over the axletree, and on these boards the body of the wagon is mounted. Passengers can sit safely inside. The empty wagon will not tilt even when the ox is unharnessed. The single-wheeled carts in South China, pushed only by a man's strength, can carry two *dan* of weight. They have to stop when they encounter any unevenness in the terrain, and they go no more than a range of 100 *li*. There are also other types of carts which are not listed and described here. Since people, who are born in the south, have never seen a cart, and those who spend their whole lives in the north have never seen a large boat, this chapter of the book simply gives a brief introduction to the main mode of transportation across the country.



佳兵第十六

【原文】

宋子曰，兵非圣人之得已也。虞舜在位五十载，而有苗犹弗率。明王圣帝，谁能去兵哉？“弧矢之利，以威天下”，其来尚矣。为老氏者，有葛天之思焉，其词有曰：“佳兵者，不祥之器。”盖言慎也。

火药机械之窍，其先凿自西番与南裔，而后乃及于中国，变幻百出，日盛月新。中国至今日，则即戎者以为第一义，岂其然哉！虽然，生人纵有巧思，乌能至此极也？

弧、矢

凡造弓，以竹与牛角为正中干质，桑枝木为两梢。弛则竹为内体，角护其外。张则角向内，而竹居外。竹一条而角两接，桑梢则其末刻楔以受弦驱。其本则贯插接榫于竹丫，而光削一面以贴角。

凡造弓，先削竹一片（竹宜秋天伐，春夏则朽蛀），中腰微亚小，两

【今译】

宋子说，兵器是圣人不得已而使用的。古时虞舜帝在位五十年，而苗人仍不服顺。明王圣帝谁能放弃兵器呢？“武器的功用在于威慑天下”，这种说法由来已久。但老子被认为有葛天氏的思想，其书中有句话说：“兵器是一种不祥之物。”这只说明使用武器时要慎重行事。

制造火药、火器的技术诀窍，最先是由西洋和南洋各国发展起来的，而后才传到中国，变幻百出，日新月异。到了今天，中国的用兵之人将其摆在首位，这可能是正确的吧！不然的话，人们纵使有巧思，如果不重视，又怎能达到这种完善的地步呢？

弓、箭

造弓以竹及牛角为弓背中部的主干材料，以桑木做弓背两端的梢。弓在松弛时，竹向内侧，而角在外侧起保护作用。张弓时角向



Chapter 16

Weapons

Songzi says that weapons are in use when wise men are at a corner. In ancient times Emperor Shun had been in power for 50 years and the Miao were not obedient to him. How can any of wise emperors ignore weapons? It has been passed on for a long time that weapons exists to terrorize the world. However Laozi was thought to agree with Getianshi's idea. In his book it was found that weapons were hoodoos, which indicates that weapons should be in use very cautiously.

The technology to make gunpowder and firearms was derived from the Western world and South Asia. After it spread to China, it changed with each passing day. China ranks in the first place making powder and firearms. It might be true. Otherwise it cannot be so perfect if there are not a lot of efforts.

Bows and Arrows

The main part of the hunch is made of bamboo and ox horn. Bamboo is inside and ox horn outside when the bow is not pulled. The bamboo part should be one entire piece while the ox horn should be divided into two parts. At the end of the bow there should be a notch to put the bowstring. The mulberry can be connected by tendon and bamboo. One side of the bamboo is made into a smooth surface for fastening the horn.

In the first place we should chop a piece of bamboo. (The bamboo should be cut in the autumn, because if it is cut in the spring and summer, it tends to



箭端

Straightening the shaft of an arrow



試弓定力

Determining the weight or pull of a bow



【原文】

头差大，约长二尺许。一面粘胶靠角，一面铺置牛筋与胶而固之。牛角当中牙接，固以胶筋。（北虜无修长牛角，则以羊角四接而束之。广弓则黄牛明角亦用，不独水牛也。）胶外固以桦皮，名曰暖靶。凡桦木关外产辽阳，北土繁生遵化，西陲繁生临洮郡，闽、广、浙亦皆有之。其皮护物，手握如软绵，故弓靶所必用。即刀柄与枪干，亦需用之。其最薄者则为刀剑鞘室也。

凡牛脊梁每只生筋一方条，约重三十两。杀取晒干，复浸水中，析破如苧麻丝。胡虜无蚕丝，弓弦处皆纠合此物为之。中华则以之铺护弓干，与为棉花弹弓弦也。凡胶乃鱼脬、杂肠所为，煎治多属宁国郡，其东海石首鱼，浙中以造白鲞者，取其脬为胶，坚固过于金铁。北虜取海鱼脬煎成，坚固与中华无异，种性则别也。天生数物，缺一良弓不成，非偶然也。

【今译】

内而竹居外。弓背用一整条竹，而角由两截组成。桑木梢则在其末端刻出缺口，以便套上弓弦的弦弧。桑木用桦与竹片穿插相连接，弓的一面削光滑并贴上牛角。

造弓时先削一片竹（竹宜于秋天砍伐，春夏砍下的竹易于朽蛀），竹片中间稍窄，两头稍宽，约长二尺。一面用胶将牛角粘上，另一面用胶粘上牛筋以加固。两段牛角之间相互咬合，用胶与牛筋固定。（东北没有长的牛角，则以四段羊角接扎。广东不只用水牛角，也用透明的黄牛角。）最外面再用胶粘上桦树皮，名曰暖靶。桦树在关外产于辽阳，华北繁生于河北遵化，西北广产于甘肃临洮，而福建、广东、浙江也都有出产。用桦皮护物，手握如软绵，所以为弓靶所必用。就是刀把与枪杆，也需要用桦皮。最薄的就用来做刀、剑的套子。

每头牛的脊梁上只生一根细长的筋，约重三十两。杀牛取出筋晒干，再浸在水中，然后析破成苧麻丝那样的纤维。东北女真族地区没有蚕丝，弓弦都是纠合牛筋做的。中原地区则用它保护弓干和作弹棉花的弓弦。胶是由鱼脬、杂肠所做的，多在宁国县熬制。东海的石首鱼在浙江用以晒鱼干，取其脬做成胶，其坚固程度胜于铜铁。东北取海鱼脬熬成的胶，与中原的胶一样坚固，只是种类不同。这些天然产物，缺少一样都做不成良弓，看来并非偶然。



decay and be damaged easily by insects.) The bamboo should be about two *chi* long with the middle being wide and the ends being narrow. The ox horn is attached to one side and tendon to the other side. The two parts of the ox horn should be meshed and glue should be firmly attached to the tendon. (There is no long ox horn in the northeast of China; therefore four pieces of sheep horn can be used instead. In Guangdong Province not only buffalo horns but also yellow cow horns can be used by the bow makers.) Then it should be glued to a piece of birch bark called the butt. Birch is mainly seen in Liaoyang in Liaoning Province, Zunhua in Hebei Province and Lintao in Gansu Province, and it can also be found in Fujian, Guangdong and Zhejiang provinces. If something is covered with birch bark it feels like cotton when people touch it. So it is necessary to use birch bark to cover the kilts of broadswords and spears. The extremely thin bark is used as the inner lining of knife scabbards and sword sheaths.

There is a long piece of sinew in the back of every ox which is about thirty *liang* in weight. After an ox is killed, take out the sinew and expose it to the sun. When it is dry, put it in water and twist it into fibres. The Manchurian tribe had no natural silk, so the bowstring was made of sinew. The pastern is usually made of the swimming bladder and entrails decocted in Ningguo County. The *Seiaena schlegeli* fish in the East Sea can be exposed to the sun, and its swimming bladder made into pastern which is harder than copper and iron. The pastern made of swimming bladder of fish in the northeast ocean can be as hard as that in the eastern ocean, though they are of different types. If one kind of materials is absent, there is no way to make a good bow.

The newly made crude-bow should be hung on a beam with fire under it. It takes from ten days to two months to dry the bow. It is then



【原文】

凡造弓，初成坯后，安置室中梁阁上，地面勿离火意。促者旬日，多者两月，透干其津液，然后取下磨光。重加筋、胶与漆，则其弓良甚。货弓之家不能俟日足者，则他日解释之患因之。凡弓弦取食柘叶蚕茧，其丝更坚韧。每条用丝线二十余根作骨，然后用线横缠紧约。缠丝分三停，隔七寸许则空一二分不缠。故弦不张弓时，可折叠三曲而收之。

往者北虏弓弦尽以牛筋为质，故夏月雨雾防其解脱，不相侵犯。今则丝弦亦广有之。涂弦或用黄蜡，或不用亦无害也。凡弓两梢系弦处，或切最厚牛皮，或削柔木为小棋子，钉粘角端，名曰垫弦，义同琴轸。放弦归返时，雄力向内，得此而抗止，不然则受损也。

凡造弓，视人力强弱为轻重。上力挽一百二十斤，过此则为虎力，亦不数出。中力减十之二三，下力及其半。彀满之时，皆能中的。但战阵之上，洞胸彻札，功必归于挽强者。而下力倘能穿杨贯

【今译】

弓坯初造成后，要放在室内梁阁高处，地面上不断用火烘烤。短则十天，多则两个月，待其中水分干透后取下磨光，重新加上牛筋、胶和漆，这样造出的弓，质量就很好了。卖弓的人家不等完全烘干便卖，则必种下日后松解的病因。弓弦用吃柘叶的蚕茧丝做成，这种丝很坚韧。每条弦用丝线二十余根作骨，然后用线横向绑紧。缠丝时分为三段，每隔七寸空出一二分不缠，因此当弓不张弦时，可将弦折成三截收藏起来。

以往东北女真族地区弓弦都以牛筋为原料，所以夏季雨雾天，因为这种弓弦吸潮松脱，都不出兵侵犯。现在丝弦也到处有了。用黄蜡涂弦防潮，不用也不要紧。弓两梢系弦的部位，要用最厚的牛皮或软木做成小棋子形状的垫子，用胶紧粘在牛角末端，名曰垫弦。其作用如同琴轸。放箭后，弓弦向内的反弹力很大，有了垫弦便可抵抗这种力量，否则会使弓身受到损伤。

造弓时要根据人力强弱来定轻重。最有力的人能挽一百二十斤，超过这个限度的叫虎力，但这种人不多。中等力量的人能挽八九十斤，力弱的只能挽六十斤左右。弓拉满弦时，都能射中目标。但战场上能穿胸透铠甲的，都要靠挽力强的射手。而力弱的如果有“穿杨贯



first polished, then reinforced with ox sinew, glue and Chinese wood lacquer to make the best product. If the bow is sold before it is completely dry, it will inevitably become loose later. The bowstring should be made from silk which is really very tough and strong. To make a string, a silk thread is tightly wound around a core of more than twenty silk threads in three sections of more than 7 *cun* each in length, leaving two gaps each about 0.1 to 0.2 *cun* in length. Such a cord can be folded into thirds when the bow is not pulled.

Because strings in Nüzhen tribe are mainly made from sinew, plus the heavy fog and rain, bows are damp and easy to get loose. It is not the time for them to invade. But there are silk strings everywhere now. Wax can be spread on the string to protect against moisture. The string will not get loose. The nock at each end of a bow for receiving the string is covered with a piece of extremely thick ox hide or soft wood. This covering cushion functions the same as the pegs on a lute. When the bow string is pulled and snapped back to its original position, a big force is developed toward the inner surface of the bow. The bow is protected from such a destructive force, otherwise it would be damaged.

The weight of the bow depends on the user's strength. The strongest man can pull 120 *jin*. If someone can surpass it we say his strength can be compared to a tiger. Average people can pull 80 to 90 *jin*, but some can only pull 60 *jin*. If the bow is fully pulled, it is easy to shoot the target. In a real war, a strong person is needed to pierce armor with arrows. If one is accurate enough to shoot a cootie from 100 steps away, this will also work. We can stamp on the string and fully pull the bow. When the bow is round, we can hook the hunch by the steelyard and move the sliding weight of the steelyard to check the weight of the bow. As for the weight of a good bow, it can be measured



【原文】

虱，则以巧胜也。凡试弓力，以足踏弦就地，称钩搭挂弓腰，弦满之时，推移秤锤所压，则知多少。其初造料分两，则上力挽强者，角与竹片削就时，约重七两。筋与胶、漆与缠约丝绳约重八钱，此其大略。中力减十分之一二，下力减十分之二三也。

凡成弓，藏时最嫌霉湿（霉气先南后北，岭南谷雨时，江南小满，江北六月，燕齐七月。然淮扬霉气独盛）。将士家或置烘厨、烘箱，日以炭火置其下（春秋雾雨皆然，不但霉气）。小卒无烘厨，则安顿灶突之上。稍怠不勤，立受朽解之患也。（近岁命南方诸省造弓解北，纷纷驳回，不知离火即坏之故，亦无人陈说本章者。）

凡箭筈，中国南方竹质，北方荏柳质，北虏桦质，随方不一。杆长二尺，镞长一寸，其大端也。凡竹箭削竹四条或三条，以胶黏合，过刀光削而圆成之。漆、丝缠约两头，名曰三不齐箭杆。浙与广南

【今译】

虱”的本事，也可以巧取胜。试弓力时，用脚将弦踏在地上，再将秤钩挂在弓腰，待弦满移动秤锤称平，便知弓力大小。造弓材料的重量，挽力强的上等弓所用牛角及削好的竹片约重七两，牛筋、胶、漆与缠丝约重八钱，这是大致情况。中等力量的弓减轻十分之一二，挽力弱的弓减轻十分之二三。

造好的弓在收藏时最忌霉湿（雾雨天气的到来是先南后北。开始的时间为：岭南是谷雨，江南是小满，江北是六月，河北、山东在七月，而以淮河、扬州地区雾雨天气最多）。有的将士之家置烘厨、烘箱，每天以炭火在下面烘热（春天、秋天下雾、下雨时也要这样做，不只是在雾雨季节）。小卒们没有烘厨，则将弓安顿在灶头烟突上。稍微一疏忽，弓就会有朽解之患。（近来朝廷命令南方各省造弓运到北方，被纷纷退回，就是因为不懂得弓一旦离开火烘就坏的道理，也没有人上奏陈述事情的原因。）

箭杆在中国南方以竹为原料，北方用荏柳，东北用桦木，各地取材都不一样。箭杆长二尺，箭镞长一寸，这是大致情况。造竹箭杆是削竹三四条，以胶黏合，再用刀削光成圆形，用漆和丝线缠紧两头，名曰“三不齐”箭杆。浙江、广南有天然生长的箭竹，不需要破开、



by the weight of the materials: oxhorn and bamboo weigh about 7 *liang* and sinew, pastern, lacquer, and the silk thread weigh about 8 *qian*. The weight of these materials is 10 to 20 percent less in a bow for the average archer, and 20 to 30 percent less for the weak archer.

Bows should be stored in places where there is no mildew or moisture. (The mildew and moisture season begins early in the south and then moves to the north. It starts at about Grain Rain south of Lingnan, at Lesser Fullness of Grain south of the Yangtze River, in June north of the Yangtze River, in July in Hebei and Shandong. However, there are more mildew and moisture weather in the regions of Huaihe and Yangzhou.) To protect bows from mildew and moisture, military officers, in the homes, dry ovens or boxes with a charcoal fire underneath (They do so not only in the mildew and rainy seasons but also in the spring and autumn when it is in foggy and rainy days.), while soldiers place their bows above the cooking stove. Any mistake in this drying process will make the bow loose. (Recently the government ordered the southern provinces that they should not only make bows and also transport them to the north. But these bows were returned one batch after another. The reason is that people then did not know the fact that bows will turn bad when they are put in the environment in the absence of fire. And no officials report this to the government.)

Arrow shafts are made from bamboo in South China, wicker in the north and birch in the northeast. It differs in different regions. The shafts are 2 *chi* long and the arrowhead is 1 *cun* in length. A bamboo arrow is made by gluing three or four bamboo strips together, which are then trimmed and polished by using a knife into a very smooth shaft. After its two ends are wound with silk threads and painted with lacquer, the shaft is known as "three unevennesses". There are natural bamboo arrows in Zhejiang and Guangdong, which can be trimmed directly into a shaft without preparing and gluing bamboo strips. A



【原文】

有生成箭竹不破合者。柳与桦杆则取彼圆直枝条而为之，微费刮削而成也。凡竹箭其体自直，不用矫揉。木杆则燥时必曲，削造时以数寸之木刻槽一条，名曰箭端。将木杆逐寸戛拖而过，其身乃直。即首尾轻重，亦由过端而均停也。

凡箭，其本刻衔口以驾弦，其末受镞。凡镞冶铁为之（《禹贡》砮石乃方物，不适用）。北虏制如桃叶枪尖，广南黎人矢镞如平面铁铲，中国则三棱锥象也。响箭则以寸木空中锥眼为窍，矢过招风而飞鸣，即《庄子》所谓“嘑矢”也。凡箭行端斜与疾慢，窍妙皆系本端翎羽之上。箭本近衔处，剪翎直贴三条，其长三寸，鼎足安顿，粘以胶，名曰箭羽。

羽以雕（雕似鹰而大，尾长翅短）膀为上，角鹰次之，鸱鹞又次之。南方造箭者，雕无望焉，即鹰、鹞亦难得之货，急用塞数，即以雁

【今译】

黏合即成箭杆。柳杆和桦杆则选择其圆直的枝条做成，稍微削、刮即成。竹箭杆本身就是直的，无须矫正。木箭杆在干燥时一定会变弯，矫正的办法是用一块几寸长的木头，上面刻一条槽，名曰箭端。将木箭杆逐寸地沿着槽拉过，杆身就会变直。即使木杆原来头尾轻重不匀，通过这样处理也可均平。

箭杆末端要刻出凹口，以便扣在弦上，另一端安上箭头。箭头用铁做成（《禹贡》所载砮石箭镞是进贡的方物，并不适用）。东北地区做的箭头像桃叶枪尖，广南黎族人的箭头像平面铁铲，中原地区的箭头则像三棱锥。响箭是以一寸长小木在中间凿个圆孔，加在箭上，箭射出后迎风而飞鸣，就是《庄子》中所谓的“嘑矢”。箭射出后，飞行的快慢和轨道的正偏，诀窍在于箭杆末端的箭羽。箭杆尾部靠近衔口处用胶粘上三条羽翎，各长三寸，鼎足直放，名曰箭羽。

箭羽以雕（雕像鹰，但比鹰大，尾长翅短）的翅毛为最好，其次是角鹰，鸱鹞又次之。南方造箭，得不到雕羽，连鹰和鹞的羽毛也很难得到，急用时就以雁翎充数，甚至也有用鹅翎的。雕翎箭飞起来比鹰



little peeling and cutting is necessary for making shafts from the straight twigs of willow and birch trees. A bamboo shaft, being naturally straight, does not need to be straightened. In contrast, a wooden shaft, tending to curve when dry, must be straightened by pulling the shaft through the straight groove when being made. This groove is carved in a section of wood several *cun* long, called "arrow straightener". During this treatment, both ends of the shaft are shaped to their proper size.

The end of the shaft should be concave so that the string can be put in. The head of the arrow is made of iron. (The flint arrow heads which are mentioned in the ancient book, *Tributes of Yu*, are products from the locals and have no practical uses.) The arrowhead looks like a spear in shape in Northeast China, a shovel in the Li tribe in Guangdong Province, and a triangular awl in the Central Plains. Whistling arrows refer to the arrows which have a wooden whistle with a round hole. When it is shot, the arrow whistles because of the hole. It is called *Haoshi* in *Zhuangzi*. The speed and the orbit of the arrow depend on the feather at the shaft end. There are three-tail feathers at the end of the arrow. These three-tail feathers called arrow feathers are about 3 *cun* long.

The best arrow feathers are the wing-feathers of an eagle (which looks like a falcon, but with a long tail and two short wings). Those from a horned falcon or hawk are the second, while feathers from owls and sparrow hawks are still lower in grade. It is difficult for the southern arrow makers to get falcons and hawks, much less eagles, so they use the wild geese's and even wild swans' feathers as the tail fins for the urgently needed arrows. An eagle-feather arrow, which can resist a gust of wind, not only travels faster than a falcon-feather arrow, but also reaches its true position after traveling only ten paces. Most arrows in the northeast



【原文】

翎，甚至鹅翎亦为之矣。凡雕翎箭行疾过鹰、鹞翎，十余步而端正，能抗风吹。北虏羽箭多出此料。鹰、鹞羽作法精工，亦恍惚焉。若鹅、雁之质，则释放之时，手不应心，而遇风斜窜者多矣。南箭不及北，由此分也。

弩

凡弩为守营兵器，不利行阵。直者名身，衡者名翼，弩牙发弦者名机。斫木为身，约长二尺许。身之首横拴度翼，其空缺度翼处，去面刻定一分（稍后则弦发不应节），去背则不论分数。面上微刻直槽一条以盛箭。其翼以柔木一条为者，名扁担弩，力最雄。或一木之下加以竹片叠承，名三撑弩，或五撑、七撑而止。身下截刻楔衔弦，其衔旁活钉牙机，上剔发弦。上弦之时，唯力是视。一人以脚踏强

【今译】

翎、鹞翎箭快，飞出十余步箭身便端正，能抗风吹。东北地区的箭羽多用雕翎。鹰羽、鹞羽如制作精细，效果也能与雕羽差不多。但鹅翎、雁翎箭在射出时手不应心，遇风便有很多斜飞的。南方的箭不及北方，原因便在这里。

弩

弩是守营兵器，不利于行军作战。弩中直的部件叫弩身，横的部件叫弩翼，扣弦发箭的机关叫弩机。砍木做成弩身，约长二尺。弩身前部横拴上两个翼，其穿孔放翼的地方离弩身的上面约一分厚（稍厚则拉弦发箭配合不准），离弩身下部距离没有固定尺寸。弩身面上要略微刻一条直槽，以承放箭枝。用一条软木做成弩翼的叫扁担弩，弹力最强。也可在一木条下加上叠在一起的竹片做成弩翼的，叫三撑弩，最多不超过五撑、七撑。弩身后半部刻一缺口扣弦，旁边钉



are finned with eagle feathers. In comparison, even the best falcon-feather arrows may still waver slightly in the wind. Arrows with feathers from wild geese and wild swans are difficult to control when charged from the bow and tend to travel astray in the wind. That is the reason why arrows made in the south are not as good as those made in the north.

Crossbows

Crossbows are usually used in defense instead of fighting at the battle fields. The crosswise bow is called a wing, while the lengthwise bow is called "a body". The device to shoot a crossbow is called "a crossbow trigger". The crossbow stock is made of wood and is about 2 *chi* in length. The upper end of the stock has a hole exactly 0.1 *cun* thick. (If it is a little bit thicker, it will hinder the movement of the bow string and shooting.) Below its lengthwise front surface, is fastened transversely to the central body of a bow. On the other hand, there is no fixed specification for the partition between the hole and the back surface of the stock. A straight, shallow groove is carved into the front surface of the stock for supporting the arrow. When the body of a crosswise bow is made from soft wood, it is called shoulder pole crossbows and is most powerful. The body of a crosswise bow can also be made by reinforcing the lower surface of an ordinary wood strip with several layers of laminated bamboo. The resulting crossbows are designated as three-ply, five-ply, and the maximum, seven-ply. The bow string must be held under tension by a tooth-like crossbow lock, which is fastened securely to a carved slot in the lower part of the stock. The lock is free to turn when its attached trigger is raised, thus releasing the bow string. The necessary force for drawing a bow string depends completely on the



连发弩

The crossbows



张弩

The crossbows



【原文】

弩而弦者，《汉书》名曰“蹶张材官”。弦放矢行，其疾无与比数。

凡弩弦以苕麻为质，缠绕以鹅翎，涂以黄蜡。其弦上翼则紧，放下仍松，故鹅翎可扱首尾于绳内。弩箭羽以箬叶为之。析破箭本，衔于其中而缠约之。其射猛兽药箭，则用草乌一味，熬成浓胶，蘸染矢刃。见血一缕则命即绝，人畜同之。凡弓箭强者行二百余步，弩箭最强者五十步而止，即过咫尺不能穿鲁缟矣。然其行疾则十倍于弓，而人物之深亦倍之。

国朝军器〔监〕造神臂弩、克敌弩，皆并发二矢、三矢者。又有诸葛弩，其上刻直槽，相承函十矢，其翼取最柔木为之。另安机木，随手扳弦而上，发去一矢，槽中又落下一矢，则又扳木上弦而发。

【今译】

上活动扳机，向上一推就可发弦射箭。上弦时全靠人力。由一个人脚踏强弩上弦的，《汉书》中称为“蹶张材官”。弩弦将箭射出，飞行快速无比。

弩弦以苕麻为质料，缠绕上鹅翎，并涂以黄蜡。弦装到翼上时拉起来很紧，但放下来仍是松的，所以鹅翎头尾都可纠夹在麻绳中。弩的箭羽用箬叶做成，箭杆下部破开一点然后将箭羽夹入其中并缠紧。射猛兽用的毒箭，用草乌头熬成浓胶，蘸染在箭头上。这种箭射出后见血即能致命，人和动物都是一样的。强弓可将箭射至二百余步远，强弩则只能至五十步而止，再远一点连薄薄的丝绢也不能穿过了。然而弩的飞行速度十倍于弓，人物之深亦加大一倍。

本朝军器监曾制造神臂弩、克敌弩，都可同时发出二三支箭。又有诸葛弩，上面刻有直槽可装入十支箭，其弩翼以最柔韧的木料做成。另外又安机木，羽箭随手扳机即可上弦。发出一枝箭，槽中又落



strength of arrow shooters. A strong archer is able to pull the string of a stout hand crossbow by holding the bow body to the ground with one foot. This action is termed in *The History of the Former Han Dynasty* as “Jue Zhang Cai Guan”. The arrows shot by crossbows are incredibly fast.

The bow strings use a ramie cord as the core. It is wound with goose feathers and covered with yellow wax. This string is tightened when it is attached to a bow body and becomes loose again after being detached from the bow. That is why both the head and the tail of the goose feathers must be twisted in the twine. Arrow tail fins are prepared by inserting bamboo leaves into a split arrow stem which is subsequently wound with silk threads. In making poison arrows for shooting wild beasts, the tubers of wild aconitum are boiled in water. The resulting poisonous liquid is smeared on the sharp edges of the arrowheads. These arrow heads can kill both human beings and animals very quickly. The victim may shed only a little blood. The arrows from powerful bows can fly about 200 paces while those from powerful crossbows only 50 paces. However the crossbow arrow travels ten times as fast and penetrates twice as deep as the bow arrow.

Once in the Ming Dynasty the officer in charge of weapons ordered to make a Shenbi crossbow and a Kedi crossbow which can discharge two or three arrows at the same time. Another weapon called Zhuge crossbow has a straight slot at the front end for holding ten arrows. The crossbow body is made of very elastic wood, while the stock is equipped with a wooden mechanism, which is raised by hand to pull the bow string onto the crossbow lock. Then the drawn string is released to shoot an arrow, which leaves some empty space on the stock. Then another arrow falls down. In order to shoot this arrow, the bow



【原文】

机巧虽工，然其力绵甚，所及二十余步而已。此民家防窃具，非军国器。其山人射猛兽者，名曰窝弩，安顿交迹之衢，机旁引线，俟兽过带发而射之。一发所获，一兽而已。

干

凡“干戈”名最古，干与戈相连得名者，后世战卒短兵驰骑者更用之。盖右手执短刀，则左手执干以蔽敌矢。古者车战之上，则有专司执干，并抵同人之受矢者。若双手执长矛与持戟、槊，则无所用之也。凡干长不过三尺，杞柳织成尺径圈，置于项下，上出五寸，亦锐其端，下则轻竿可执。若盾名中干，则步卒所持以蔽矢并拒槊者，俗所谓旁牌是也。

火 药 料

火药、火器，今时妄想进身博官者，人人张目而道，著书以献，

【今译】

下一枝，则又扳机木上弦发箭。这种弩虽很精巧，但力量很小，只能射二十余步而已。此乃民家防备盗窃的用具，而非军国兵器。还有山区人射猛兽用的，叫窝弩，安设在野兽出没的路上，机旁有引线，待野兽经过，带动拉线箭便射出。一箭只能射死一头野兽而已。

盾

“干戈”这一词出现得最早，是将干与戈连起来而得名的，因为后世的战卒手持短兵器驰骋作战时常配合使用的缘故。他们右手执短刀，而左手执盾以蔽敌箭。古时士卒在战车上有专人执盾，以保护同车人免中敌箭。如果双手持长矛、戟、槊，则无法用盾了。盾长不过三尺，将杞柳枝织成直径一尺的圆圈放在颈部下面，盾上部有五寸长的尖齿，下部安一轻竿供手持。另有一种叫“中干”，是步兵所持用以挡箭或长矛的，俗称傍牌。

火 药 原 料

火药、火器，当今妄想升迁当官的人，个个都大肆议论，著书献



string is again pulled by raising the mechanism, and then released. Although it is skillfully constructed, the Zhuge crossbow is less powerful, as demonstrated by its short range of a little more than twenty paces. This explains why it is used only to ward off burglars, not as a military weapon. In mountains the crossbows used to shoot wild beasts are called *wo* crossbows. They are put in places where there are animals. When people see the animals, they will pull the trigger and shoot the animals. One arrow is used only for one animal.

Shields

The shield and the spear are the oldest weapons, which the ancient Chinese put together. Soldiers hold a spear in one hand and a shield in the other simultaneously. Spears are used for attacks and shields are used for defense. Some soldiers in ancient chariot warfare held shields to protect the other soldiers from arrows from enemies. If soldiers keep a spear and a sword in each hand it is impossible to hold a shield. Shields are not longer than 3 *chi*, with the upper inside surface attached to a woven willow loop 1 *chi* in diameter. The shields triangularly shaped top has a 5-*cun*-long apex in the center, while its bottom is fastened to a bamboo pole as a handle. A medium-sized shield, known as buckler, is used by the foot soldier to ward off arrows and halberds. It is commonly called a Bangpai.

Raw Materials for Making Gunpowder

Materials for making gunpowder and incendiary weapons. At present, people who want to get promoted propose to use gunpowder and firearms. They wanted to write books so that they can present them to the imperial court. However, what they said may not necessarily base



【原文】

未必尽由试验。然亦粗载数页，附于卷内。凡火药以硝石、硫黄为主，草木灰为辅。硝性至阴，硫性至阳，阴阳两神物相遇于无隙可容之中。其出也，人物膺之，魂散惊而魄齑粉。凡硝性主直，直击者硝九而硫一。硫性主横，爆击者硝七而硫三。其佐使之灰，则青杨、枯杉、桦根、箬叶、蜀葵、毛竹根、茄秸之类，烧使存性，而其中箬叶为最燥也。

凡火攻有毒火、神火、法火、烂火、喷火。毒火以砒、礞砂为君，金汁、银锈、人粪和制。神火以朱砂、雄黄、雌黄为君。烂火以礞砂、瓷末、牙皂、秦椒配合。飞火以朱砂、石黄、轻粉、草乌、巴豆配合。劫营火则用桐油、松香。此其大略。其狼粪烟昼黑夜红，迎风直上，与江豚灰能逆风而炽，皆须试见而后详之。

【今译】

给朝廷，但他们所说的未必都经过试验。但是这里也总要略载数页，附于本卷。火药以硝石、硫黄为主，木炭为辅。硝石性属至阴，而硫性属至阳，这两种属于至阴、至阳的物质相遇于密闭空间中，爆炸起来，人或动物被炸到都会魂飞魄散而粉身碎骨。硝石性主直爆（纵向爆炸），直射的火药中硝占十分之九而硫占十分之一。硫性主横爆（横向爆炸），所以爆炸性火药中硝石占十分之七而硫占十分之三。作为辅助剂的木炭，是用青杨、枯杉、桦根、箬竹叶、蜀葵、毛竹根、茄秆之类烧成炭，其中箬竹叶做成的最为猛烈。

火攻用的火药有毒火、神火、法火、烂火、喷火等。毒火药以砒霜、礞砂为主，再与金汁、银锈、人粪配制。神火药以朱砂、雄黄、雌黄为主。烂火则以礞砂、瓷屑、牙皂、秦椒配合。飞火以朱砂、石黄、轻粉、草乌、巴豆配合。劫营火是用桐油、松香。这是大略情况。至于说狼粪烟白天黑、晚上红，能迎风直上；还有江豚灰能逆风而燃。这些特性都需要试验、亲见而后才能明瞭。



on experiment. Therefore, a couple of pages should be devoted to say something about this in this book. The main materials for gunpowder are saltpeter and sulphur with a certain amount of charcoal. Saltpeter and sulphur are respectively negative and positive. When saltpeter and sulphur meet in a hermetical situation, an explosion occurs, then it can kill both humans and animals. Saltpeter is an upward projecting agent. The gunpowder used for straight shooting takes up 90 percent saltpeter and 10 percent sulphur. In comparison, sulphur is a lateral blasting agent. The gunpowder employed for making mines and bombs consists of 70 percent saltpeter and 30 percent sulphur. Charcoal, the auxiliary component of gunpowder, is produced by burning the wood of willow, pine, birch root, bamboo leaves, hollyhocks, bamboo roots, or egg-plant stalks. Among these plants, bamboo leaf is the most fiery.

Gunpowder for fire attack can be divided into several kinds, such as "poisonous fire", "divine fire", "magical fire", "scorching fire", and "spraying fire", etc. When white arsenic and *Sal ammoniac* are used as the main material with golden liquid, silver rust, and human manure as the subsidiary ingredients, the resulting product is called poisonous gunpowder. When vermilion, orpiment, and realgar are used as the main materials, the gunpowder is called "divine fire". "Scorching fire" is mixed with borax, porcelain powder, *Gleditschia japonica*, and *Xanthoxylum piperitum*. "Flying fire" is the mixture of vermilion, orpiment, calomel, aconitum, and *Croton tiglium*. For attacking a fort with fire, the incendiary is a mixture of tung oil and rosin. This is a brief summary of incendiary weapons. It is said that the smoke of burning wolf dung, being black in daylight and red at night, rises straight into the air, and that the ash of a river whale can be inflamed by wind. However, these two types of materials must be tested, after which a detailed description can be made.



【原文】

硝 石

凡硝，华夷皆生，中国专产西北。若东南贩者不给官引，则以为私货而罪之。硝质与盐同母，大地之下潮气蒸成，现于地面。近水而土薄者成盐，近山而土厚者成硝。以其入水即消溶，故名为消。长、淮以北，节过中秋，即居室之中隔日扫地，可取少许以供煎炼。凡硝三所最多，出蜀中者曰川硝，生山西者俗呼盐硝，生山东者俗呼土硝。

凡硝刮扫取时（墙中亦或迸出），入缸内水浸一宿，秽杂之物浮于面上，掠取去时，然后入釜注水煎炼。硝化水干，倾于器内，经过一宿即结成硝。其上浮者曰芒硝，芒长者曰马牙硝，其下猥杂者曰朴硝。欲去杂还纯，再入水煎炼。入莱菔数枚同煮熟，倾入盆中，经宿结成白雪，则呼盆硝。凡制火药，牙硝、盆硝功用皆同。凡取硝制药，少者用新瓦焙，多者用土釜焙，潮气一干，即取研末。凡

【今译】

硝 石

硝石在中国和外国都有，而中国只产于西北。东南地区贩硝石的拿不到官方发下的运销证件，就以贩卖私货论罪。硝石与食盐在本质上同为盐类，由大地潮气蒸发而出现于地面。近水而土薄的成为食盐，近山而土厚的成为硝。因硝入水后即消溶，故一度名为“消石”。长江、淮河以北每过中秋之后，即使在室内隔日扫地，也可取得少量的硝以供煎炼。硝石在三个地方出产得最多，出于四川的叫川硝，生于山西的俗称盐硝，产于山东的俗称土硝。

将硝刮扫下来后（土墙中也有冒出硝的），放进缸里用水浸一夜，捞去浮在上面的秽杂之物，然后入锅加水煎炼。待硝溶水干，倒于容器内，经过一夜，即结成硝。浮在上面的叫芒硝，芒长的叫马牙硝，下面沉有杂质的叫朴硝。要除去杂质而提纯，便再将硝放入水中煎煮，加入萝卜数块在锅内一同煮熟，再倒进盆里，过一夜结成雪白的结晶，称为盆硝。制造火药时，牙硝、盆硝功用相同。用硝制火药，少量的在新瓦片上烘焙，多的用土锅烘焙，烘干后即取来研成



Salt peter

Salt peter can be found both in China and in Western countries. In China salt peter is only found in northwest China. If salt peter without license is sold in the southeast, a trader should be accused of smuggling. Salt peter and salt are the same in nature, both of which form when the atmosphere vaporizes on the ground. When the surface soil is thin and close to water, the product is salt. In contrast, salt peter is formed on the thick surface soil close to mountains. Salt peter can be dissolved in water. After mid-autumn, salt peter can be collected from the ground when the houses are cleaned in the area north of the Yangtze River and the Huaishui River. There are three places where the production of salt peter is very rich. They are *Chuan* Salt peter in Sichuan Province, Salt Salt peter in Shanxi Province, and Earth Salt peter in Shandong Province.

When salt peter is scrapped from walls (from which there may exist salt peter), it should be put into a jar and soaked in water for one night to exclude the impurities, and then water should be added and boiled. When salt peter is completely dissolved in water, we can pour it into a container in which salt peter crystallizes overnight. The upper layer of the impure crystals is called "white-beard" salt peter, the longer crystals, "horse-teeth salt peter", and the bottom layer crystals are called *pu* salt peter. In order to exclude impurities, we need to put salt peter in water and boil it together with many pieces of turnips, then pour this into a basin for crystallization overnight. It is called basin salt peter. "white-beard" salt peter and Basin salt peter are the same when they are used to make gunpowder. However, before use, the salt peter should be



【原文】

研硝不以铁碾入石臼，相激火生，则祸不可测。凡硝配定何药分两，入黄同研，木灰则从后增入。凡硝既焙之后，经久潮性复生，使用巨炮多从临期装载也。

硫 黄

凡硫黄配硝而后，火药成声。北狄无黄之国空繁硝产，故中国有严禁。凡燃炮，拈硝与木灰为引线，黄不入内，入黄则不透关。凡碾黄难碎，每黄一两和硝一钱同碾，则立成微尘细末也。

火 器

西洋炮：熟铜铸就，圆形若铜鼓。引放时半里之内人马受惊死。（平地熬引炮有关捩，前行遇坎方止。点引之人反走坠入深坑内，炮声在高头，放者方不丧命。）

【今译】

粉末。研硝时不可用铁器在石臼中碾，否则铁、石摩擦产生火花，造成的灾祸就不堪设想了。硝量多少按所配某种火药方子而定，与硫一起磨研，木炭最后加入。硝石烘干之后，放久又易返潮，所以大炮所用火药多是临时装载的。

硫 黄

硫黄与硝〔以及木炭〕配合后，火药才能发生爆炸。北方没有硫黄的蒙族地区，产硝虽多而用不上，所以内地严禁向那里贩运硫黄。点炮时将硝与木炭捻成引线，不加入硫黄，加了硫引线就不灵。硫黄很难碾碎，每一两硫加一钱硝同碾，就能很快碾成细粉了。

火 器

西洋炮：是用熟铜铸成的，呈铜鼓那样的圆形。引放时，半里之内人和马都会受惊而死。（平地上点燃引线放炮时，要操纵转动的部件将炮身移至有坑的地方停下来。炮手往回跑并跳到深坑内。炮在上面爆发，炮手方不至于丧命。）



roasted either on a piece of newly made tile or in an earthen pot, depending on the amount to be roasted. When the saltpeter is dry it can be ground into powder in a stone mortar, but not with an iron roller, because any spark produced by the latter could start an explosion, which might be disastrous. The powder is mixed with a predetermined amount of sulphur, in accordance with the kind of gunpowder to be prepared and ground again. Charcoal ash is then added to the mixture at last. Dry saltpeter can absorb moisture when it is stored for a long time. Therefore, in large cannons a new shipment of freshly prepared gunpowder should be used.

Sulphur

When sulphur is combined with saltpeter and charcoal, an explosion occurs. There is no sulfur in the area where the Mongolian tribes live in the north. Even if there was plenty of saltpeter, it would be impossible to make gunpowder. Therefore, it is forbidden to sell sulphur to the Mongolians. For firing a cannon, the fuse is made by mixing saltpeter with charcoal, but not with sulphur. It is difficult to crush sulphur with a roller. But if one *qian* of saltpeter is added to one *liang* of sulphur and they are crushed together, the sulphur is easily rolled into fine powder.

Firearms

Western cannons are made from copper and are round like a copper drum. When they are fired, both men and horses within a half *li* will be killed. (When the fuse is lighted on the flat ground, the cannon should be moved to the place where there is a pit and the operator should jump into a deep pit. In this way he will not be killed when it fires.)



【原文】

红夷炮：铸铁为之，身长丈许，用以守城。中藏铁弹并火药数斗，飞激二里，膺其锋者为齑粉。凡炮熬引内灼时，先往后坐千钧力，其位须墙抵住，墙崩者其常。

大将军、二将军、即红夷之次，在中国为巨物。

佛朗机：水战舟头用。

三眼铳、百子连珠炮。

地雷：埋伏土中，竹管通引，冲土起击，其身从其炸裂。所谓横击，用黄多者。

混江龙：漆固皮囊，裹炮沉于水底，岸上带索引机。囊中悬吊火石、火镰，索机一动，其中自发。敌舟行过，遇之则败，然此终痴物也。

鸟铳：凡鸟铳长约三尺，铁管载药，嵌盛木棍之中，以便手握。凡锤鸟铳，先以铁槌一条大如箸者为冷骨，裹红铁锤成。先为三接，

【今译】

红夷炮：用铸铁做成，炮身長一丈，用以守城。炮膛里装有几斗铁弹与火药，炮弹激飞二里，被击中的马上成为碎粉。大炮引爆时，首先产生从前向后的很大的后坐力，因此炮位必须有墙顶住，墙被崩塌是常见现象。

大将军、二将军：比红夷炮小点，在中国算是巨炮。

佛朗机：水战时装在船头用。

三眼铳、百子连珠炮。

地雷：埋伏在地中，用竹管穿通引线，引爆后冲开泥土而爆炸，地雷本身也同时炸裂了。这就是用硫量较多的火药的横向爆炸现象。

混江龙（水雷）：是将炮药装在皮囊里并用漆密固，沉在水底，岸上牵绳引机爆炸。皮囊中悬吊火石、火镰，绳子一牵动机关，囊里自动发爆。当敌船驶过，遇上即炸坏。然而这毕竟是一种笨重不灵的东西。

鸟铳：长约三尺，用铁管装火药，铁管嵌在木棍上以便手握。锤制鸟铳时，先以一条筷子粗的铁条作为锤锻的冷模，将烧红的铁裹在



Dutch cannons are made from cast iron. They are one *zhang* in length and used for defending castles. The chamber is filled with several *dou* of iron balls and gunpowder. Upon firing, the iron ball is projected over a distance of two *li*, so as to pulverize horses in its path. When the cannon is fired, it brings with great recoiling force from the front backward. So the cannon should be anchored against walls. It is often seen that the walls collapse because of the recoiling force.

“Great Commander”, “Second Commander” is smaller than a Dutch cannon.

Portuguese cannons are used on board warships.

“Three-barrel pistol” and “string-of-100-ball cannons” are commonly used cannons and guns.

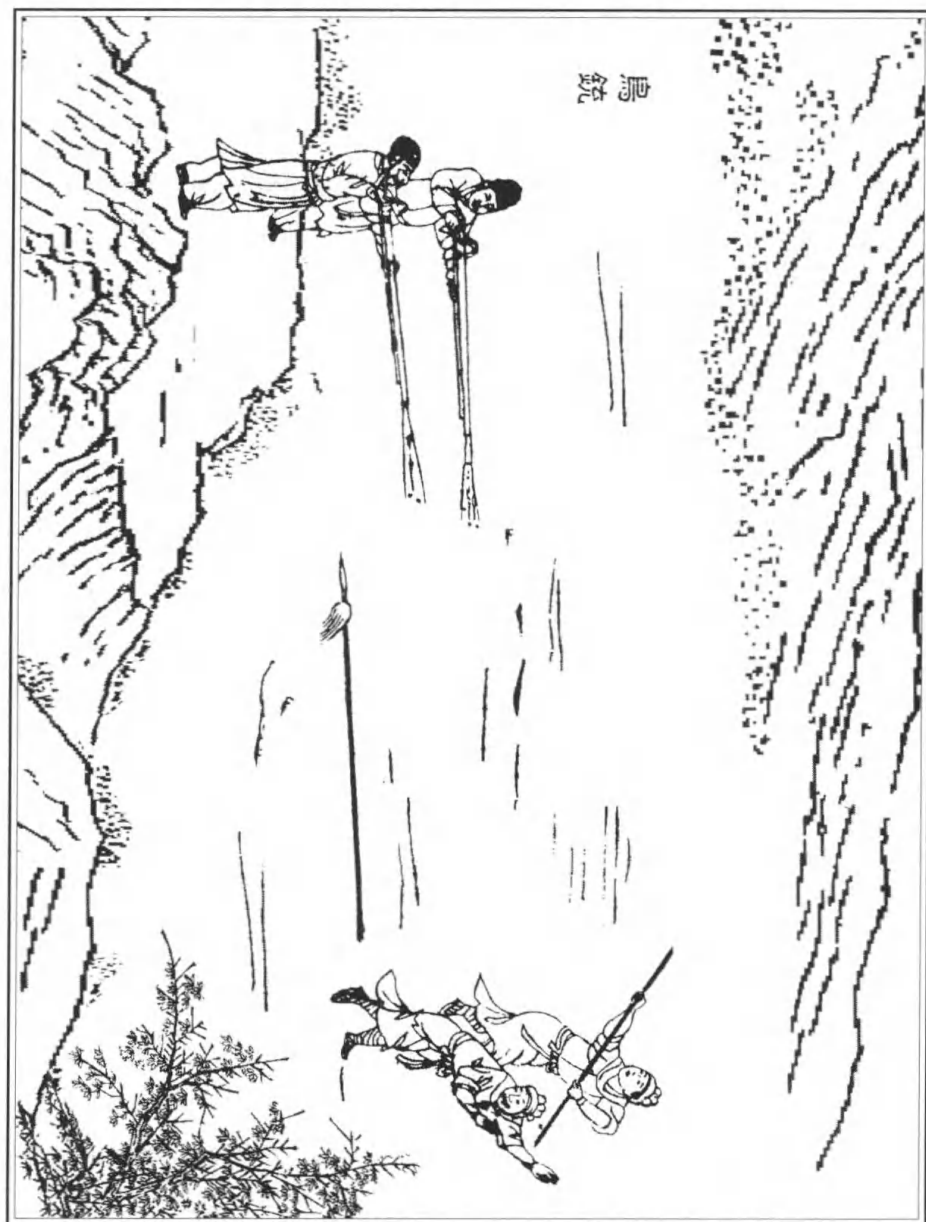
Land mines are buried in the ground. After its fuse is lighted with an inflamed tinder kept in a bamboo tube, the mine explodes and results in an upward blast. This is the phenomenon of lateral blasting when more sulphur is added to the gunpowder.

Submarine mines are made by covering cannon with a leather bag painted with lacquer. It is sunk to the bottom body of the water. The trigger in the leather bag is connected to a rope leading to the shore. When the rope is pulled, the trigger is automatically pulled and a passing enemy ship will be destroyed. However, it is still a clumsy and ineffective firearm.

A bird pistol is about three *chi* long. Fill an iron tube with gunpowder. Put the iron tube onto a hand-held wooden stock. The tube is made by hammering three pieces of red-hot iron, each of which is wrapped around a cold iron bar with a diameter of a chopstick. The three iron tubes are combined into a crude tube by heating and pressing their adjoining ends together. The muzzle of the tube is polished



鸟銃
The bird pistol





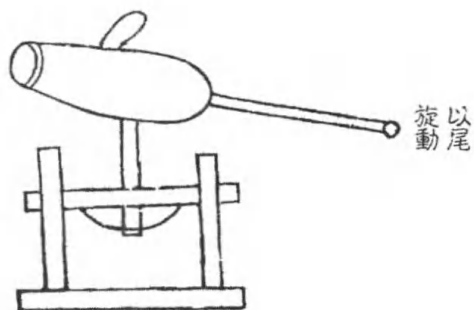
万人敌

The revolving bombs (killer-of-myriads)



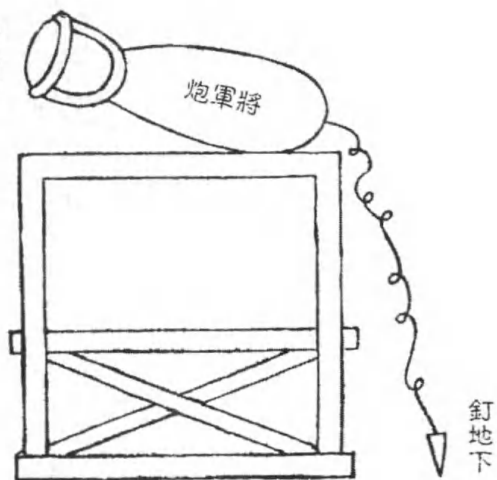
炮珠連子百轉面八

精銅鑄長四尺中
容法藥一升五合



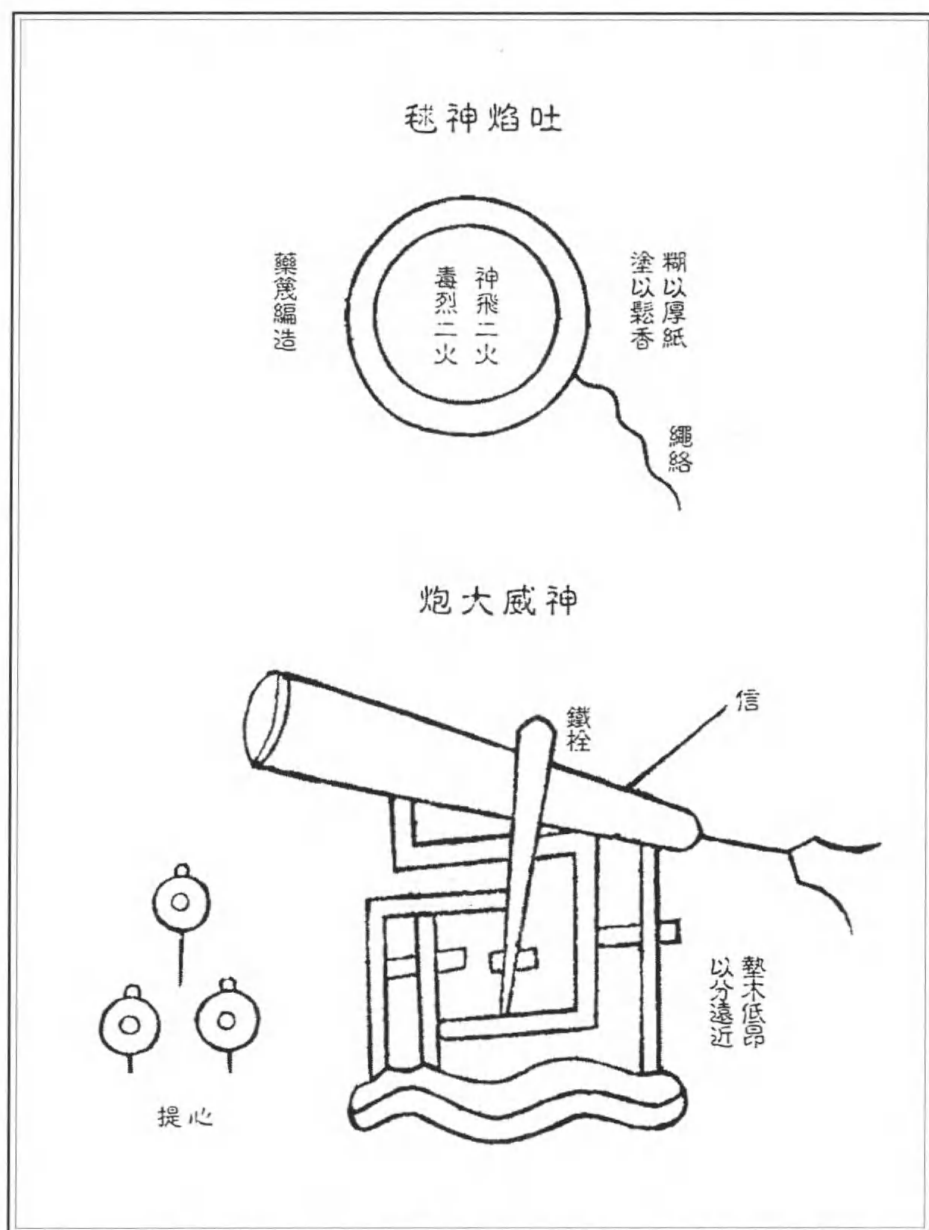
炮烟神

小炮無
發毒霧



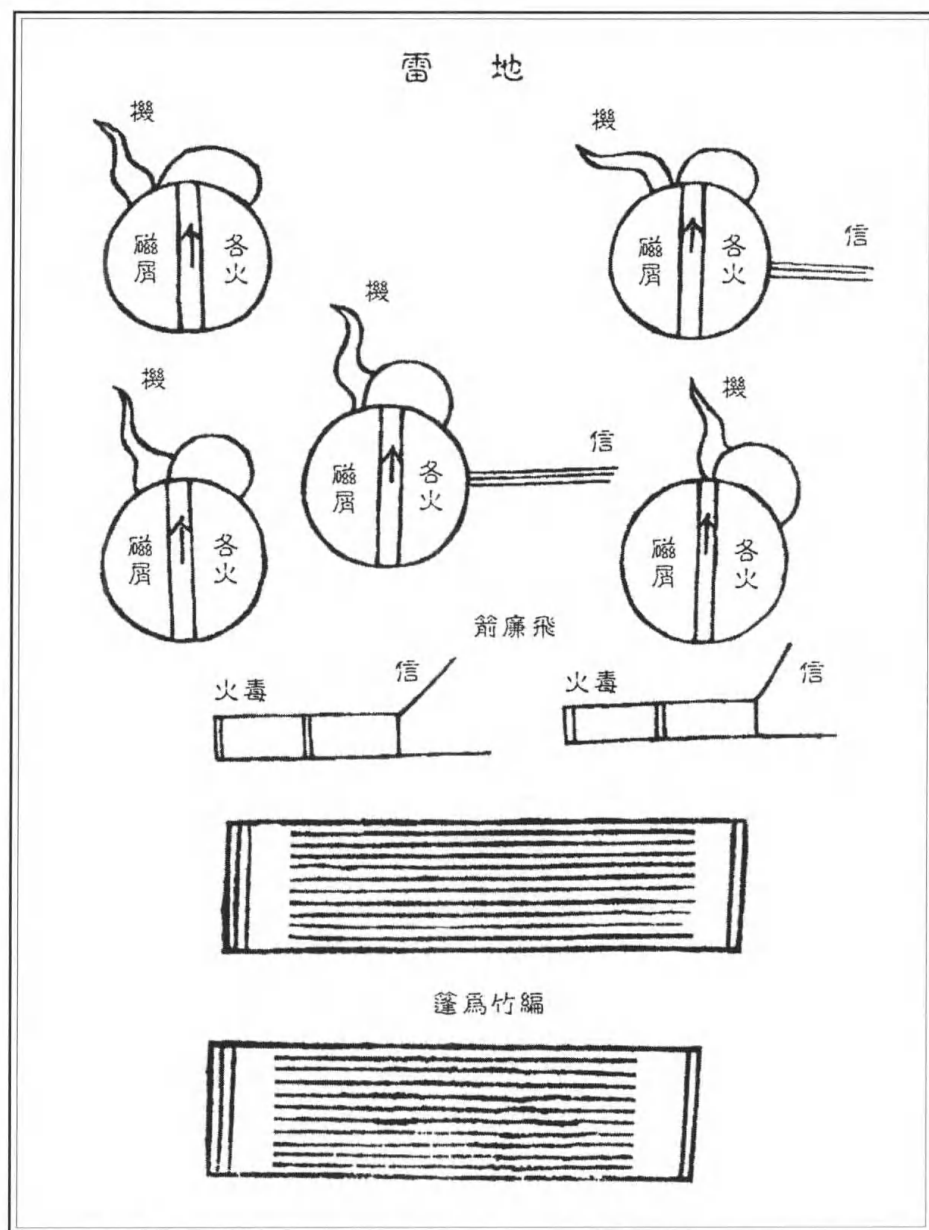
百子連珠炮 將軍炮

The string-of-100-ball cannons



神威大炮

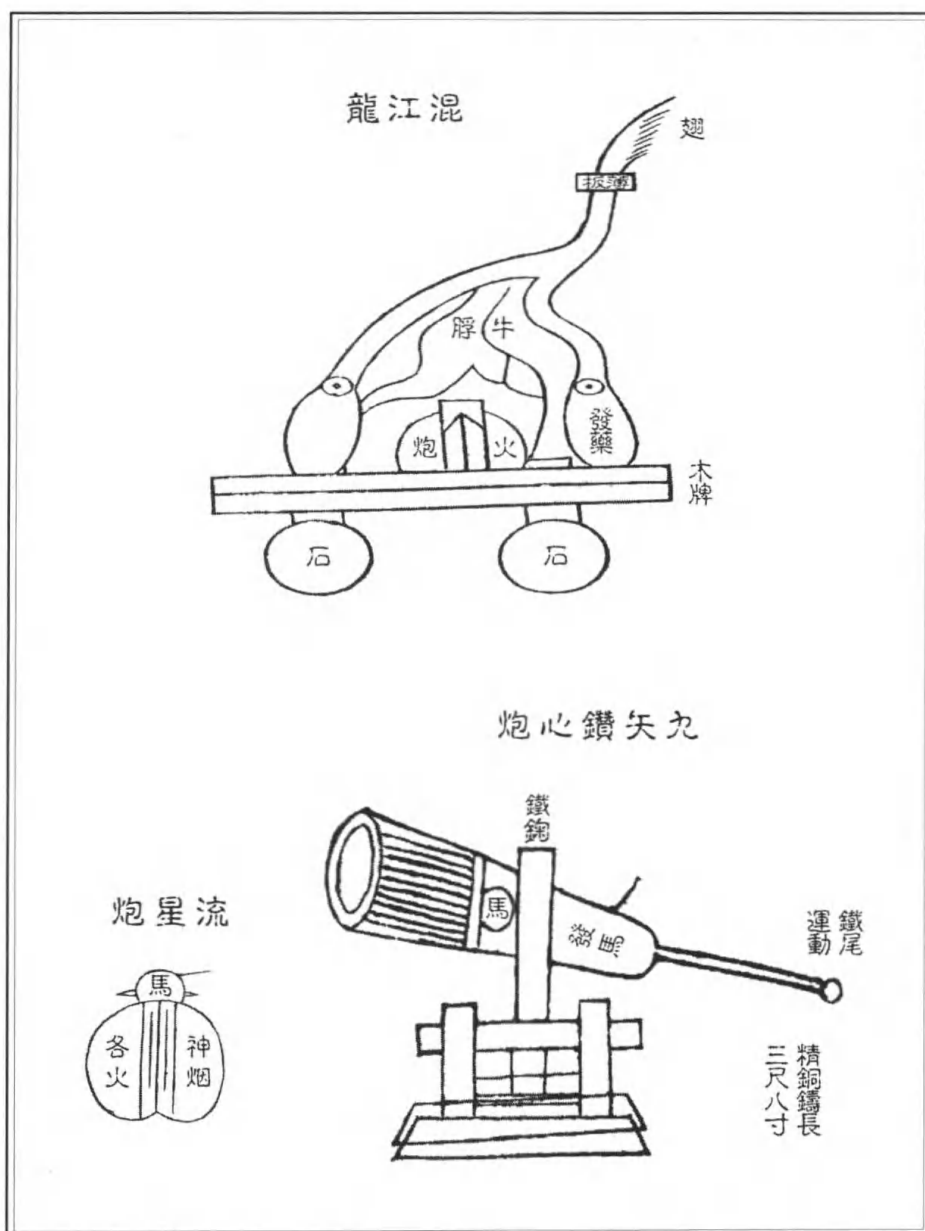
The invincible cannon



地雷
The land mine



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流星炮 混江龍

The meteoric cannon

The submarine mine



【原文】

接口炽红，竭力撞合。合后以四棱钢锥如箸大者，透转其中使极光净，则发药无阻滞。其本身近处，管亦大于末，所以容受火药。每铳约载配硝一钱二分，铅铁弹子二钱。发药不用信引，孔口通内处露硝分厘，捶熟苧麻点火。左手握铳对敌，右手发铁机逼苧火于硝上，则一发而去。鸟雀遇于三十步内者，羽肉皆粉碎，五十步外方有完形，若百步则铳力竭矣。鸟枪行远过二百步，制方仿佛鸟铳，而身長药多，亦皆倍此也。

万人敌：凡外郡小邑，乘城却敌，有炮力不具者，即有空悬火炮而痴重难使者，则万人敌近制随宜可用，不必拘执一方也。盖硝黄

【今译】

铁条外锤打成铁管。先做三段铁管，接口处烧红后竭力锤打接合。接合后以筷子粗的四棱钢锥插入铁管中旋转，使管内壁极其光滑，这样火药爆发时就不会有阻滞。铁管近铳身的一端较粗，以便装入火药。每铳约装火药一钱二分、铅弹及铁弹子二钱，点药不用引信，通向铁管内部的孔口处露出一硝，用捶烂的苧麻点火。左手握铳对准敌人，右手扣扳机将苧麻火逼到硝上，一下子就发射出去了。鸟雀在三十步内中弹，则羽肉皆成粉碎，五十步以外才能保持完形，如果到了一百步，铳力就消竭了。鸟枪射程二百步，制法与鸟铳相似，只是管长与装药量都要多出一倍。

万人敌：在边远的小城里守城御敌，或者没有火炮，或者虽有火炮而笨重难用。在这种情况下，近来制造出的万人敌，就很适合使



with a four-edged steel reamer, with a diameter of a chopstick, so as to obtain a smooth finish, which is necessary for the free discharging of pellets. The stock end of the tube, which holds gunpowder and pellets, is larger than the discharging end in diameter. Each pistol is loaded with 0.12 *liang* of gunpowder and 2 *qian* of lead and iron pellets. A lighted hemp wick is used to fire the pistol instead of a fuse. When firing at enemies, the shooter holds a pistol in his left hand and uses his right hand to pull the trigger of the gun-lock. This brings the lighted hemp to the top end of the nipple orifice which is filled with gunpowder. Such pellets will shatter birds into pieces within a distance of 30 paces, kill them without tearing their bodies at more than 50 paces, and are extremely weak at 100 paces. However, the pellets discharged from a bird gun can travel more than 200 paces. A bird gun is twice as long and contains twice as much gunpowder as the bird pistol. They are similar in the method of manufacturing.

The revolving bombs are used in frontier areas to guard the towns from being attacked by enemies where either there are no cannons to use or they are too heavy to use. In such cases, the revolving bombs are employed because they can be used under any geographical conditions. The bombs made of saltpeter or sulphur are so destructive that they can kill thousands of enemies. The methods for making the revolving bombs are as follows: through a small hole on top, fill hollowed dry clay balls with gunpowder, put a fuse in it, and frame them with wood; or put the clay inside wooden buckets, fill them up with gunpowder and seal them up. If making revolving bombs with clay balls, you have to frame them with wood lest they break into pieces when thrown at enemies. When enemies attack the town, light the fuses and throw the bombs beyond the city walls. The bombs shoot fire and revolve on



【原文】

火力所射，千军万马立时糜烂。其法，用宿干空中泥团，上留小眼，筑实硝黄火药，掺入毒火、神火，由人变通增损。贯药安信而后，外以木架匡围。或有即用木桶，而塑泥实其内郭者，其义亦同。若泥团，必用木框，所以防掷投先碎也。敌攻城时，燃灼引信，抛掷城下。火力出腾，八面旋转。旋向内时，则城墙抵住，不伤我兵。旋向外时，则敌人马皆无辜。此为守城第一器。而能通火药之性、火器之方者，聪明由人。作者不上十年，守土者留心可也。

【今译】

用，而不受环境限制。因为硝石和硫黄产生的火力，可使千军万马立时炸成粉碎。其制法是，用干燥很长时间的中空的泥团，从上面留出小眼装实火药，掺入毒火、神火，用量由人灵活变通。装药并安上引信之后，泥团外面以木框围起来。也可以用木桶，而将泥抹在桶内周边做成内壳，道理是一样的。如用泥团，则必须用木框，以防投掷时先摔碎。敌人攻城时，燃着引信，抛掷于城下，这时火力冲出，八方旋转。旋向内时，被城墙挡住，不伤我兵。旋向外时，那么敌军的人马都不能幸免。这是守城的头等武器。凡是通晓火药、火器技术的人，都可以发挥自己的聪明才智。造出这种武器还不到十年，守卫国土的人要密切留心啊！

the ground. While they are revolving, the city wall prevents them from hurting the defending soldiers. When revolving away from the city walls, the bombs kill all the enemy soldiers and horses. This is the best weapon for defending a city or town. The time required for a manufacturer to learn how to make gunpowder and weapons is usually less than 10 years, depending on his intelligence. Those who are in charge of defense work must take this point into consideration very carefully.





曲蘖第十七

【原文】

宋子曰，狱讼日繁，酒流生祸，其源则何辜。祀天追远，沉吟《商颂》、《周雅》之间。若作酒醴之资曲蘖也，殆圣作而明述矣。唯是五谷菁华变幻，得水而凝，感风而化。供用岐黄者神其名，而坚固食馐者丹其色。君臣自古配合日新，眉寿介而宿痼怯，其功不可殚述。自非炎黄作祖，末流聪明，乌能竟其术哉！

酒 母

凡酿酒，必资曲药成信。无曲即佳米珍黍，空造不成。古来曲造酒，蘖造醴。后世厌醴味薄，遂至失传，则并蘖法亦亡。凡曲，麦、

【今译】

宋子说，酗酒过度便滋事生祸，因而打官司的日渐增多，但祸根并不在酒曲的制造上。古人祭天祀祖须捧上美酒，在仪式、宴会上欣赏《商颂》、《周雅》中的诗歌、乐章时，要饮酒以助兴。酿酒就必须依靠酒曲，这在古代圣贤著作中都有所阐明。酒曲是由五谷精华经水提炼、遇风变化而制造出来的。供作医药上用的酒曲叫神曲，保持食物美味并呈红色的酒曲叫丹曲。制药曲时主料和辅料的配合方法自古以来就不断更新，在助人长寿、医治宿病顽疾等方面的功用，实不可尽述。如果没有我们的祖先炎帝神农氏和黄帝轩辕氏开创的事业和后代人的聪明才智，怎么能使这种技术达到如此完善的程度呢！

酒 曲

酿酒必须依靠曲药作为引子。没有曲即使用佳米、珍黍也造不出酒来。古时用曲造一般的酒，用蘖造甜酒。后来人们嫌甜酒味淡，



Chapter 17

Yeasts

Songzi says that an increased number of crimes and litigations are caused by the bad effect of alcoholic drink on society. However, the curse does not lie in the brewing process itself. Good wine should be dedicated to God when a memorial ceremony is held. Wine is drunk to add to the fun when poems and music from *The Book of Poetry* are enjoyed at ceremonies and banquets. As is clarified in the works of ancient oracles, yeast is indispensable to the brewing process. When making yeasts, the essence of the five grains is changed. After the grains are ground, they are mixed with water and kneaded into solid forms, then they become yeast by the breeze. The yeast used by physicians is called “medicinal yeast” and those red ones, which can make food delicious, are called “red yeast”. Since ancient times, the blending methods of the principal materials and supplementary materials in making medicinal yeast have been improved. The functions of medicinal yeast in macrobiotics and in curing inveterate diseases are measureless. Without the great achievements accomplished by our ancestors Emperor Yan and Emperor Huang and the abilities and wisdom of the later generations, how else could this technique become so perfect?

Wine Yeast

“Wine yeast” is a must in the brewing process. Without it, wine will not be made even with the best rice. In ancient times, regular wine



【原文】

米、面随方土造，南北不同，其义则一。凡麦曲，大、小麦皆可用。造者将麦连皮并水淘净，晒干，时宜盛暑天。磨碎，即以淘麦水和作块，用楮叶包扎，悬风处，或用稻秸罨黄，经四十九日取用。

造面曲用白面五斤、黄豆五升，以蓼汁煮烂，再用辣蓼末五两、杏仁泥十两，和踏成饼，楮叶包悬，与稻秸罨黄，法亦同前。其用糯米粉与自然蓼汁溲和成饼，生黄收用者，罨法与时日亦无不同也。其入诸般君臣与草药，少者数味，多者百味，则各土各法，亦不可殚述。近代燕京则以薏苡仁为君，入曲造薏酒。浙中宁、绍则以绿

【今译】

便不再普及，制蘖酿甜酒的方法也跟着失传。制酒曲用麦、米、面粉，原料因地制宜，南方和北方各不相同，但原理是一样的。做麦曲用大麦、小麦均可。制曲的人将带皮的麦用井水洗净，晒干，时间最好在盛夏天。将麦磨碎，以洗麦水拌合做成块状，用楮树叶子包扎起来悬挂在通风处，或用稻草盖上使之发黄，经四十九天后取出使用。

造面曲是用白面五斤、黄豆五升，用蓼汁煮烂，再用辣蓼末五两、杏仁泥十两，混合踏压做成饼，用楮叶包扎悬在高处，或用稻草掩盖使它生出黄衣，方法同前。用糯米粉时，则将其与自然蓼汁浸泡做成饼，待生黄毛而收用，其掩盖方法与所需时间与前述亦无不同。向其中加入的各种主、次配料和草药，少则数味，多则百味。各地都有不同的方法，也不可尽述。近代北京则以薏苡仁为主，加



is made with yeast and sweet wine with maltose. Afterwards, however, the method lost its popularity since the sweet wine was not considered strong enough. Accordingly, the methods for making maltose and brewing sweet wine became lost, too. The raw materials for making wine yeast are mainly wheat, rice or flour depending on the local conditions. The materials used are different in South and North China. The principles are the same, though. Both barley and wheat are appropriate for making wheat yeast. Wheat with hulls should be washed clean with well water and then dried in the sun. This is better done in midsummer. The wheat should be ground and then kneaded into blocks with water used in washing wheat. Then the blocks of wheat triturate should be bound up with mulberry leaves and hung in a draught. They should be covered with straw in order to grow yellow spores. They are taken out and used in forty-nine days.

“Flour yeast” is made by blending 5 *jin* of flour and 5 *sheng* of soybeans boiled with the *Polygonum hydropiper* juice. Then 5 *liang* of *Polygonum flaccidum* powder and 10 *liang* of mashed almond are added to it and formed into cakes by blending and pressing. The cake is then wrapped with mulberry leaves and hung high or covered with straw to grow yellow spores. The method is the same as the one explained above. When glutinous rice powder is used, marinate it in the natural *Polygonum hydropiper* juice and make cakes out of it. It can be usable after yellow spores have grown on it. The covering method and the time needed are the same as the method mentioned before. The number of principal and supplementary materials and herbal medicine added to it ranges from several ingredients to a hundred. Since the methods are different from one another according to different local conditions, they won't be explained all here. At recent times in Beijing,



【原文】

豆为君，入曲造豆酒。二酒颇擅天下佳雄（别载《酒经》）。

凡造酒母家，生黄未足，视候不勤，盥拭不洁，则疵药数丸动辄败人石米。故市曲之家必信著名闻，而后不负酿者。凡燕齐黄酒曲药，多从淮郡造成，载于舟车北市。南方曲酒酿出即成红色者，用曲与淮郡所造相同，统名大曲。但淮郡市者打成砖片，而南方则用饼团。其曲一味，蓼身为气脉，而米、麦为质料，但必用已成曲、酒糟为媒合。此糟不知相承起自何代，犹之烧矾之必用旧矾滓云。

神 曲

凡造神曲所以入药，乃医家别于酒母者。法起唐时，其曲不通酿用也。造者专用白面，每百斤入青蒿自然汁、马蓼、苍耳自然汁

【今译】

入酒曲造出蕙酒。浙江宁波、绍兴是以绿豆为主，加入曲造出豆酒。这两种酒在国内颇为闻名而列为佳酒（另载入《酒经》一书中）。

造酒曲的人家，如果曲料生黄毛的时间不足，看管不勤，手擦洗不干净，只要有几粒坏曲，就会轻易败坏别人整担的粮食。因此卖酒曲的人家必须守信用，重名誉，才不致辜负酿酒的人。河北、山东造黄酒的曲药，多由淮安造成，用舟车贩运到北方。南方酿造的红色的酒，所用的曲与淮安所造的相同，统名之为大曲。但淮安所卖的曲是打成砖块，而南方则制成饼团。每一种酒曲都要加入蓼粉，起通气作用。以米、麦为基本原料，还必须加入已造成的曲和酒糟作为媒介。加入酒糟不知是从什么时代传下来的，其原理就像烧矾石时必须用旧矾滓一样。

药 曲

制造神曲为的是当药用，医家将其称为神曲，是为了与酿酒的酒曲区别开来。制神曲的方法起于唐代，这种曲不能用来酿酒。造神曲的人专用白面，每百斤面加入青蒿、马蓼、苍耳原汁拌合做成



Coix laacryma kernels are the principal material and wine yeast is added to produce Job's tears wine. In Ningbo and Shaoxing of Zhejiang Province, bean wine is made with mung beans and yeast. These two kinds of wine are very famous throughout China and are considered as vintage wines. (More information can be found in *The Book of Wine Brewing*.)

At the wine-yeast maker's home, if the culturing of moulds is not properly done, or not well tended to, or if the hands are not properly cleaned, then a few pellets of the bad yeast can spoil the whole *dan* of the wine maker's grain. For reliable yeast, the wine maker must get it from those who have good reputations and are well known as wine-yeast makers. Yeast used in Hebei and Shandong for making yellow wine is usually made in Huai'an and then transported to North China by boats and carts. The yeast used to make the red wine in South China is the same as that in Huai'an. They are both called "fire yeast". However, the yeast of Huai'an is shaped into square blocks, while in South China, cakes. Some old wine-mash must be added to either kind of yeast to aerate it. If rice and wheat are used as the basic materials, yeast and wine mash must be added before they are fermented as medium. It's not clear now when the method of adding wine mash originated. This is similar to the use of old vitriol wastes in calcinating vitriol stone.

Medicinal Yeast

The aim of making medicinal yeast is to use it as medicine. Doctors refer to it as medicinal yeast in order to differentiate it from wine yeast used for making wine. The technique for making medicinal yeast can be traced back to the Tang Dynasty. This kind of yeast cannot be used to make wine. White flour is the special material used to make



【原文】

相和作饼，麻叶或楮叶包罨，如造酱黄法。待生黄衣，即晒收之。其用他药配合，则听好医者增入，若无定方也。

丹 曲

凡丹曲一种，法出近代。其义臭腐神奇，其法气精变化。世间鱼肉最朽腐物，而此物薄施涂抹，能固其质于炎暑之中，经历旬日，蛆、蝇不敢近，色味不离初，盖奇药也。

凡造法用粳稻米，不拘早晚。舂杵极其精细，水浸一七日，其气臭恶不可闻，则取入长流河水漂净（必用山河流水，大江者不可用）。漂后恶臭犹不可解，入甑蒸饭，则转成香气，其香芬甚。凡蒸此米成饭，初一蒸半生即止，不及其熟。出离釜中，以冷水一沃，气冷再

【今译】

饼，用麻叶或楮叶包藏掩盖，像做豆酱的黄曲那样。待外面长出一层黄衣，就晒干收取。再用什么其他药配合，则听由医生增减，并没有固定的配方。

红 曲

有一种红曲，制法出现于近代。其意义在于“化臭腐为神奇”，其方法在于米和气的变化。世间鱼和肉是最易腐烂的东西，但以红曲薄薄地在鱼肉上涂抹一层后，能于炎夏之中保持新鲜。放置十天，蛆和蝇不敢接近，色味仍保持原样，这真是一种奇药！

造红曲用黏性较差的粳稻米，早稻、晚稻都可以。将米舂捣得极其精细，水浸七日后，发出的气味臭不可闻，则取出放在流动的河水中洗净（必须用山河流水，不可用大江水）。漂洗后，恶臭之味仍未消除，把它放入甑中蒸成饭后，就变成芳香的气味了。在蒸米成饭时，先蒸至半生半熟即停止，不可蒸熟。在离开蒸锅时，在饭上用冷水一浇，待冷却后再蒸至熟透。蒸熟后，将几石米饭堆在一起放



medicinal yeast. Every 100 *jin* of flour should be added with the fumet of *Artemisia apiacea*, *Polygonum nodosum* and *Anthium sibiricum* and kneaded into cakes which should be wrapped or covered with hemp leaves or mulberry leaves. The method is similar to making yellow yeast for fermented bean sauce. After the cakes are covered with yellow mould, they are dried in the sun and stored. As for the addition of other drugs, follow the doctors' directions because there is no fixed prescription for it.

Red Yeast

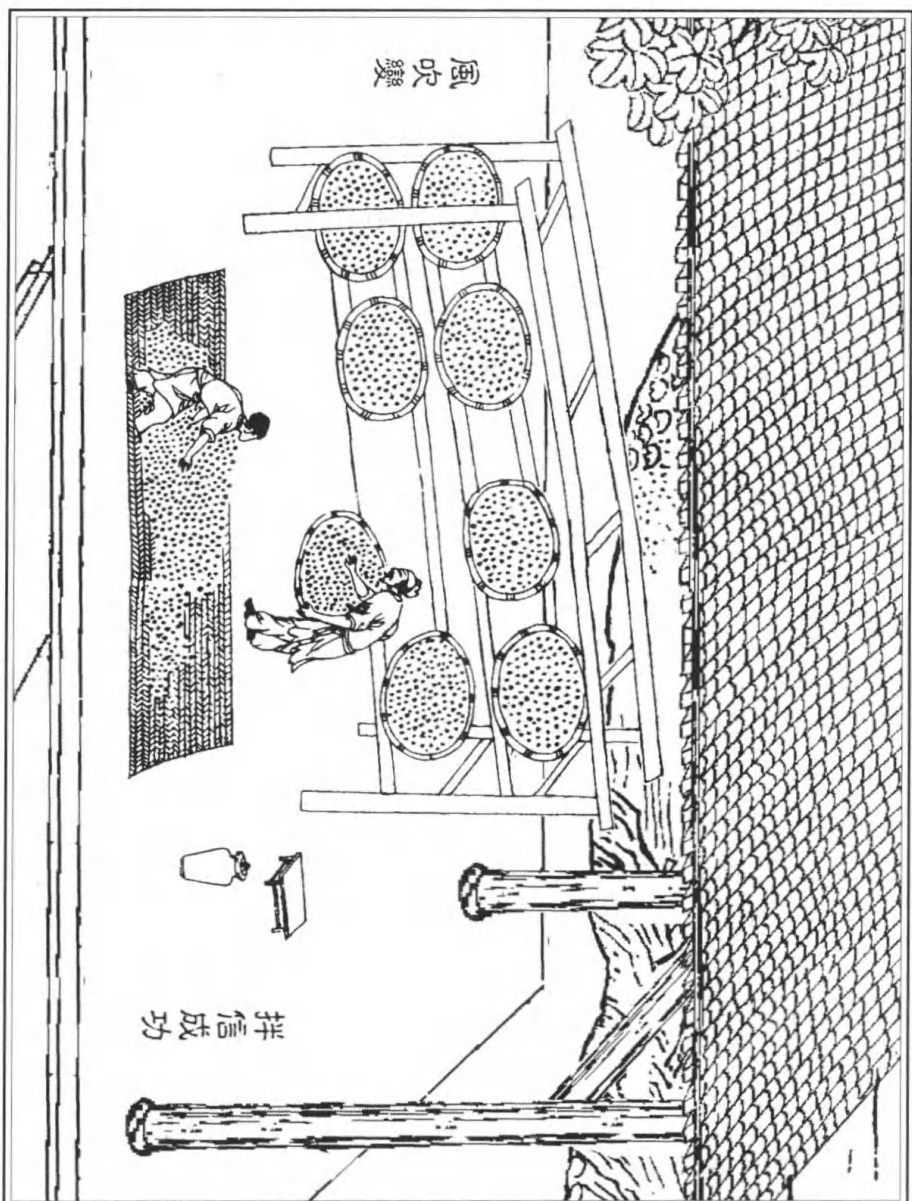
The method for making red yeast was developed in more recent times. It involves the transformation of the essences of grains. Fish and meat perish most easily. However, only a thin layer of red yeast coated on fish will keep the fish fresh during hot summers. Maggots and flies will stay away from the fish for as long as ten days, and the color and taste of the fish remain the same. What a marvelous medicine!

Glutinous polished long-grained rice, whether early rice or late rice, is appropriate for making red yeast. The rice should be pestled very fine. After being soaked in water for seven days, the stench will be unbearable. (Then take the pestled rice out and wash it with river water flowing from the mountains instead of that from great rivers.) Even after washing, the stench will still exist. However, the aroma will become pleasant if the rice is put into a rice steamer and braized into cooked rice. The steaming process should be paused when the rice is half-cooked. Next, some cold water should be poured onto it. After it is cooled, steam it until it is fully cooked. At last, pile several *dan* of rice together and put yeast into it. The principal ingredient for making yeast should be high-quality red wine mash. The cooked rice is placed together, several *dan* to a



流水漂米

Washing fermented rice in a mountain stream



拌信通风

Using air to ferment steamed rice in bamboo trays



【原文】

蒸，则令极熟矣。熟后，数石共积一堆拌信。

凡曲信必用绝佳红酒糟为料。每糟一斗，入马蓼自然汁三升，明矾水和化。每曲饭一石，入信二斤，乘饭热时，数人捷手拌匀，初热拌至冷。候视曲信入饭久复微温，则信至矣。凡饭拌信后，倾入箩内，过矾水一次，然后分散入篾盘，登架乘风。后此风力为政，水火无功。

凡曲饭入盘，每盘约载五升。其屋室宜高大，防瓦上暑气侵迫。室面宜向南，防西晒。一个时中翻拌约三次。候视者七日之中，即坐卧盘架之下，眠不敢安，中宵数起。其初时雪白色，经一二日成至黄色，黄转褐，褐转赭，赭转红，红极复转微黄。目击风中变幻，

【今译】

入曲种。

曲种必须以特好的红酒糟为料。每一斗糟加入马蓼原汁三升，再加明矾水和匀。每一石酒糟加入曲种二斤，乘饭熟时，由数人迅速拌匀，由热拌到冷。当曲种拌入饭中，经过一段时间温度又微有升高时，就说明曲种已拌成功。曲种拌入饭后，倒入箩内，淋一次明矾水，然后分散摊在竹盘内，放在架上通风。此后通风便是关键，而水火则不起作用了。

曲饭放入盘中，每盘约盛五升。放曲饭的房屋应当高大宽敞，防止瓦上的热气袭入。房屋应面向南，以防西晒。两个小时内约翻拌三次。七日之内要有人日夜守候观察，坐卧在盘架附近不敢安睡，半夜还要起来几次。曲饭开始时呈雪白色，经一天后成为深黄色，又由黄转褐，由褐转成赤褐色，由赤褐色变为红色，至深红色最后又转为微黄色。目视曲饭在空气中所经历的这一系列颜色的变化，叫做“生黄曲”。用这种方法制成的红曲，其价钱与所需的人力、物



heap, for the addition of leaven.

For making red yeast, the leaven must be made from the best red-colored wine mash at a proportion of one peck of mash to three *sheng* of the natural juice of smartweed mixed in alum water. Two *jin* of this leaven are added to every *dan* of steamed rice when the latter is still hot, then mixed quickly by several pairs of hands until it is cooled. The mixture should then stand for a long time under constant observation, so that the rice can be sufficiently fermented by the leaven. Then pour the rice with the yeast into a bamboo tray and drench it with some aluminous water before spreading it out in a bamboo tray. In the end, put the tray in a draught. From now on, the air will be important for culturing the yeast, fire and water will serve no practical purposes.

The cooked rice with yeast added should be put onto plates, each of which has five-*sheng* of rice on it. The house in which the steamed rice with yeast is placed should be tall and spacious so that the heat from the tiles won't get in. The house should face south so that it can not be affected by the strong afternoon sun. During every two-hour period, the rice should be turned over three times. For seven days, there should always be someone who watches and observes the rice without any sleep. At the beginning, the steamed rice with yeast is snowy white. After one day it turns dark black. Then the black rice turns brown, brown to foxy, foxy to red, dark red, and finally light yellow. The color changing process of the rice in the air is called "cultivation of yellow yeast". The price, manpower and the material resources required for red yeast to be produced in this way are twice that of the regular yeast. Every time when the rice turns brown from black or to red from brown, it will be necessary to wash it with water. No more washing is required after the rice turns red. Workers are required to



【原文】

名曰生黄曲。则其价与人物之力皆倍于凡曲也。凡黄色转褐，褐转红，皆过水一度。红则不复入水。凡此造物，曲工盥手与洗净盘簞，皆令极洁。一毫滓秽，则败乃事也。

【今译】

力都比一般的曲增加一倍。当曲饭由黄色变成褐色、由褐色变成红色时，都要过一次水。变红以后便不再加水。造红曲的制曲工要勤洗手，并将竹盘和细竹席洗净，周围的一切都要干干净净。只要有一点脏滓落入，都会使制曲归于失败。

wash their hands frequently and should also keep the bamboo trays, bamboo mattresses and the surrounding equipment clean, since the slightest bit of dirt will bring the entire operation to ruin.





珠玉第十八

【原文】

宋子曰，玉蕴山辉，珠涵水媚，此理诚然乎哉，抑意逆之说也？大凡天地生物，光明者昏浊之反，滋润者枯涩之仇，贵在此则贱在彼矣。合浦、于阗行程相去二万里，珠雄于此，玉峙于彼，无胫而来，以宠爱人寰之中，而辉煌廊庙之上。使中华无端宝藏折节而推上坐焉。岂中国辉山媚水者萃在人身，而天地菁华只有此数哉？

珠

凡珍珠必产蚌腹，映月成胎，经年最久，乃为至宝。其云蛇腹、龙颌、鲛皮有珠者，妄也。凡中国珠必产雷、廉二池。三代以前，淮、扬亦南国地，得珠稍近《禹贡》“淮夷蜃珠”，或后互市之便，

【今译】

宋子说，据说藏玉之山闪光，含珠之水明媚，这种说法果真有道理，还是一种臆测之说？大凡自然界生成之物，有光亮的也有暗浊的，有滋润的也有干涩的，两相对立，贵在此而贱在彼。合浦和于阗行程相距二万里，珍珠雄踞于此间，美玉耸立于彼处，但都很快便贩运至各地受到人们的喜爱，在宫廷里争光夺彩。珠宝玉器使中华无尽宝藏贬低身价，而被推于首位。难道中国的宝物只是佩带在人身上的珠玉，而天地间的精华就只有这些吗？

珍珠

珍珠必定产于蚌腹之中，感受月光成胎，经历多年才成宝物。所谓蛇腹、龙颌、鲛皮含有珠，那是妄说。中国珍珠必定产于雷州、廉州两处的珠池。夏、商、周三代以前的淮安、扬州地区，对中原而言也算是南方地区，所得到的珠较接近于《禹贡》所载的“淮水



Chapter 18

Pearls and Gems

Songzi says that the story goes that the mountains that produce jades are gleamy and the water that has pearls is radiant. Does this statement make sense? Or is it just a hypothesis? Everything in nature has its opposite, so that when something sparkles, there must be something dim, and when something is moist, there must be something dry. Though the distance between Hepu, the famous pearl-producing area, and Yutian, the area teeming with jades, is 20,000 *li*, these gems are purchased and cherished by people everywhere and even strived for their favors in the palace. Pearls and jades are considered as the primacy superior to other precious gems in China. However are these gems, adorning human bodies, the only treasures in China and thus the essence of excellence in the world?

Pearls

Pearls are produced in mussels and formed in moonlight and finally become treasures after years. The story that pearls can be found in snake abdomens, dragon jaws, and shark skins is totally ridiculous. The pearls produced in China come from the two pearl beds of Leizhou in Guangdong and Lianzhou in Guangxi. Before the Xia, Shang and Zhou dynasties, the Huai'an and Yangzhou areas were also considered as southern areas, which were closer to the "pearls produced from *Unio margaritiferas* in the Huaihe River" recorded in *Tributes of Yu* (*Yu Gong*). These pearls might have been gotten by the Huai people



【原文】

非必责其土产也。金采蒲西路，元采杨村直沽口，皆传记相承之妄，何尝得珠？至云忽吕古江出珠，则夷地，非中国也。

凡蚌孕珠，乃无质而生质。他物形小，而居水族者，吞噬弘多，寿以不永。蚌则环包坚甲，无隙可投，即吞腹，囫囵不能消化，故独得百年、千年，成就无价之宝也。凡蚌孕珠，即千仞水底，一逢圆月中天，即开甲仰照，取月精以成其魄。中秋月明，则老蚌犹喜甚。若彻晓无云，则随月东升西没，转侧其身而映照之。他海滨无珠者，潮汐震撼，蚌无安身静存之地也。

凡廉州池自乌泥、独揽沙至于青莺，可百八十里。雷州池自对乐岛斜望石城界，可百五十里。胥户采珠，每岁必以三月，时杀牲祭海神，极其虔诚。胥户生啖海腥，入水能视水色，知蛟龙所在，则不敢侵犯。凡采珠舶，其制视他舟横阔而圆，多载草荐于上。经过水漩，

【今译】

地区产的蚌珠”，也可能是互市交换而得，不一定是当地土产。金代珍珠采于蒲西路、元代采自杨村直沽口，都是沿袭了错误记载，这些地方何尝得珠？至于说忽吕古江出珠，那是东北少数民族地区，而不是中原地区了。

蚌孕育珍珠是从无到有。水族中其余形体小的，多被吞食掉，故寿命不长。但蚌则周身包以坚壳，无隙可入，即使被吞入腹内，也保持完整而消化不了，故独得百年、千年之寿而成无价之宝。蚌孕育珠在深水底，每逢月圆当空，蚌就开壳仰照，取月精以成珍珠。当中秋明月时，老蚌特别高兴，如果通宵无云，就随月东升西落的方向转动身体照取月光。有些海滨无珠，是因潮汐震撼，使蚌无安身静存之地。

廉州的珠池从乌泥、独揽沙以至青莺，约有一百八十里，雷州的珠池从对乐岛到斜对面的石城境内，约有一百五十里。沿海的水上居民每年必于三月采珠，到时杀牲畜祭海神极其虔诚。他们生吃海味，入水能审视水中的一切，知蛟龙所在，便避开不去侵犯。采珠船的形状比其余船宽阔而呈圆形，船上装有很多草垫。船经漩涡时则投以草

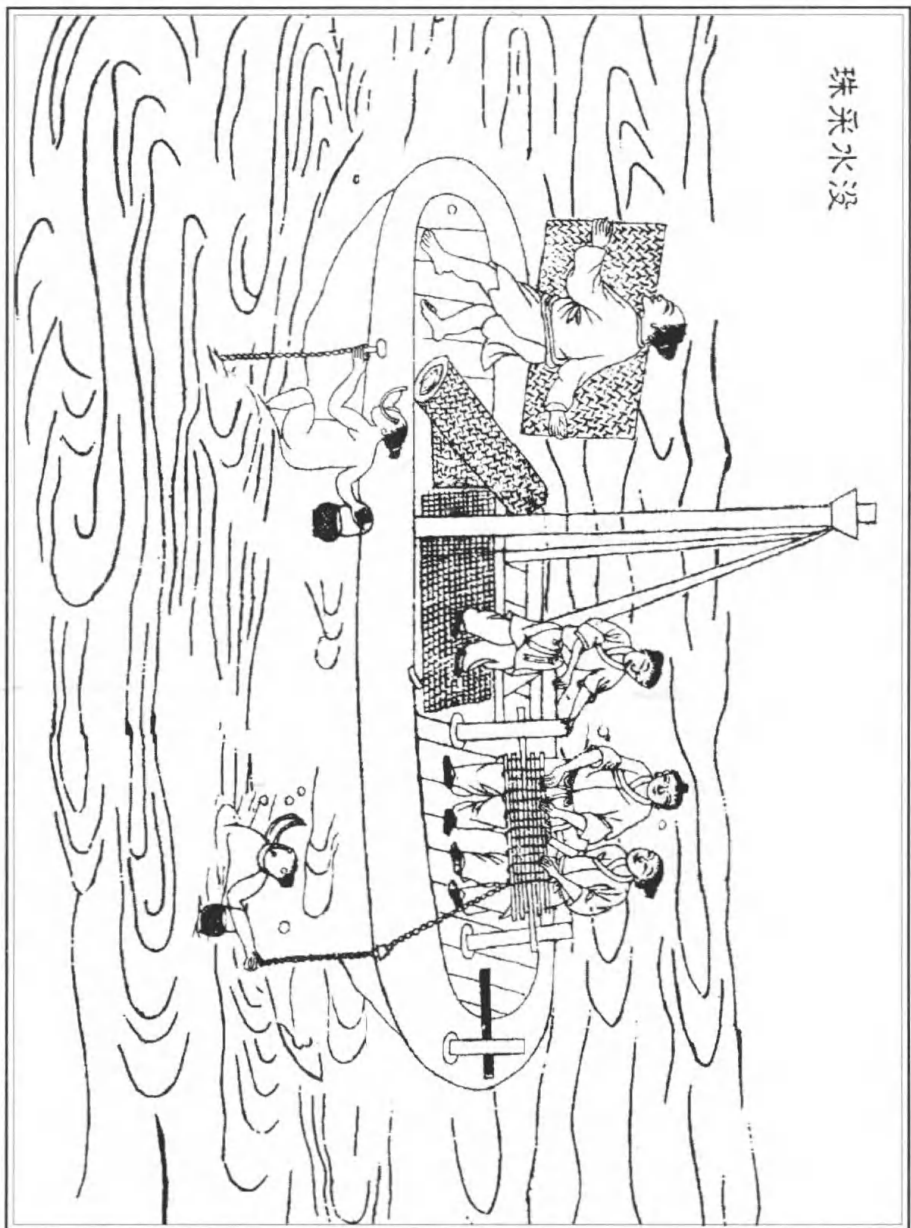


through trade, since the tributes were not necessarily local products. The statement that pearls are produced in Puxi County in the Jin Dynasty and in Yangcun Zhigukou in the Yuan Dynasty all result from the wrong records since these areas never produced pearls. The pearl-producing area, the Hu Lügu River, is in the minority area in Northeast China, and not in the Central Plains.

The gestation of pearls by mussels is a long process, from nothing to a pearl. Small aquatic animals usually have short life-spans because they are eaten by other animals. Mussels, however, are protected by hard shells which will keep them safe, even if they are swallowed by other animals. As a result, a pearl can enjoy a life as long as hundreds even thousands of years and become priceless. Mussels live in deep water. Whenever there is a full moon, the mussels will open their shells and imbibe the pith of the moonlight so that pearls are formed from it. As a result, the mussels like it when the Mid-Autumn Day comes. If it is cloudless for the whole night, the mussels will turn themselves along with the moving direction of the moon in order to get the moonlight. The reason why some sea sides have no mussels is that the tides make them unable to make shelters there.

The 180-*li* pearl bed in Lianzhou ranges from Wuni and Dulansha to Qingying and the 150-*li* pearl pond in Leizhou extends from Duile Island to the Stone City that is diagonally opposite the island. The coastal residents dive for pearls in March every year after they offer sacrifices to the sea gods. Before diving into the sea, they eat raw seafood in order to see everything clearly in the water. Once they find where those fierce sea animals are, they stay away from them. The pearl boats are circular and are broader than other boats. Onboard there are many straw mattresses which are thrown into the water when

珠采水没



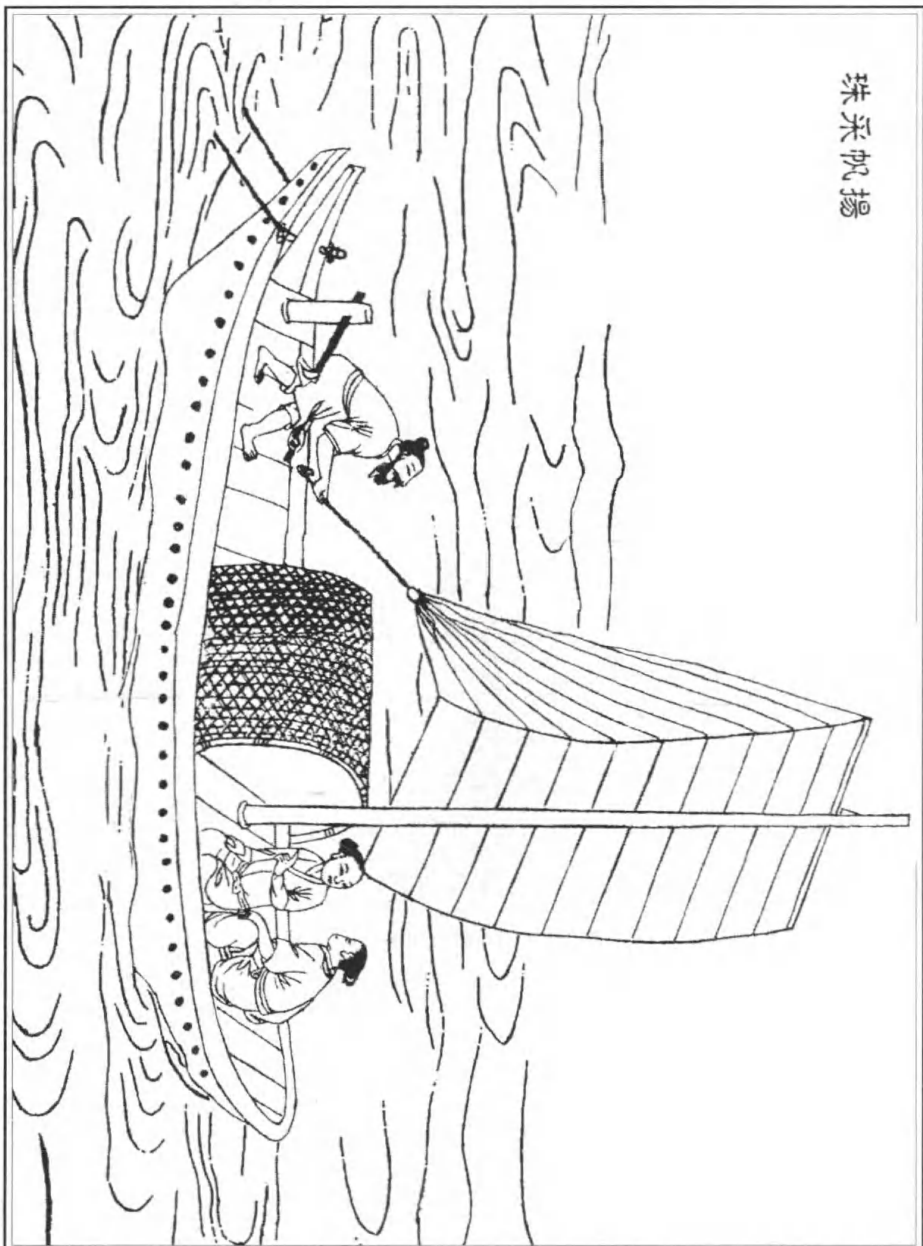
没水采珠

Divers collecting mussels and oysters





珠采帆揚



揚帆采珠

Collecting mussels and oysters with a toothed drag



【原文】

则掷荐投之，舟乃无恙。舟中以长绳系没人腰，携篮投水。

凡没人以锡造弯环空管，其本缺处对掩没人口鼻，令舒透呼吸于中，别以熟皮包络耳项之际。极深者至四五百尺，拾蚌篮中。气逼则撼绳，其上急提引上，无命者或葬鱼腹。凡没人出水，煮热毳急覆之，缓则寒栗死。宋朝李招讨设法以铁为构，最后木柱扳口，两角坠石，用麻绳作兜如囊状，绳系舶两旁，乘风扬帆而兜取之。然亦有漂溺之患。今置户两法并用之。

凡珠在蚌，如玉在璞。初不识其贵贱，剖取而识之。自五分至一寸五分径者为大品。小平似覆釜，一边光彩微似镀金者，此名瑯

【今译】

垫，可安全通过。船上以长绳系住潜水人的腰部，持采珠篮沉入水中。

采珠人潜水带上锡制的弯管，管的末端开口对准其口鼻以便呼吸，另用软皮带子包在耳颈之间。最深可潜至四五百尺，拾蚌放入篮中。呼吸困难时则摇绳，船上人急速拉上，命运不好的或许就要葬身于鱼腹。潜水人出水时，立刻以煮熟了的毛毯盖在其身上，慢了就会冷死。宋朝的招讨官李某设法以铁做成耙状框架，架的后部用木柱接口，两边挂上石坠，框架四周套上麻绳网袋，再用绳将其系在船头两边，乘风扬帆兜取珍珠贝。但这种装置有漂失和沉溺的危险，现在水上居民则两种方法并用。

珠在蚌中，如玉在璞石中一样。蚌刚采出时尚不知其有无价值，待剖破后才知道是否有珠。直径从五分至一寸五分的是大珠，还有一种珍珠略呈扁圆，像倒放的锅，一边光彩略像镀金的，叫瑯珠，



there are swirls so that the boats can get across safely. The diver is tied with a long rope at the waist, which is attached to a winch and attended by people on the boat, and dives into the deep water carrying a basket.

The pearl diver wears a bent tin tube. The bottom opening of the tube is attached to his mouth and nose so that he can breathe. In addition, his ears are wrapped with a soft leather strip. A pearl diver can dive as deep as four to five hundred *chi*. His job is to pick up mussels and put them into the baskets. He must shake the rope for help when he can not hold his breath any longer and he will be pulled up immediately by the people onboard or he will probably be eaten by big fishes. As soon as he is out of water, he should be covered with a steamed blanket, otherwise he will be frozen to death. In the Song Dynasty, an official named Li designed and constructed an iron harrow, the frame of which has a toothed drag. Stones are hung on both sides of the frame. A wooden pole is fixed vertically on top of the frame. A sack, which is made of hemp rope, is fastened to all sides of the frame. Then the frame is tied to both sides of the boat. The boat sails with the wind, while the toothed drag digs up the mussels and oysters which, due to the motion of the boat, roll into the sack. However, there are risks that these fixtures are likely to float away or sink with this method. Nowadays the coastal residents use both methods.

The fact that pearls are produced in the mussels is just like the fact that jades are discovered from the rock crust. The value of mussels cannot be decided until they are cut open and examined to see whether there are pearls in them or not. Pearls with a diameter ranging from 0.5 *cun* to 1.5 *cun* can be called large pearls. The kind of oblate pearls with the color of gilt is called pendant pearl, which is slightly oval in



【原文】

珠，其值一颗千金矣。古来“明月”、“夜光”即此便是。白昼晴明，檐下看有光一线闪烁不定。“夜光”乃其美号，非真有昏夜放光之珠也。次则走珠，置平底盘中，圆转无定歇，价亦与瑇珠相仿。（化者之身受含一粒，则不复朽坏，故帝王之家重价购此。）次则滑珠，色光而形不甚圆。次则螺蚶珠，次官、雨珠，次税珠，次葱符珠。幼珠如粱粟，常珠如豌豆。碎而碎者曰玢。自夜光至于碎玢，譬均一人身，而王公至于氓隶也。

凡珠只有此数，采取太频，则其生不继。经数十年不采，则蚌乃安其身，繁其子孙而广孕宝质。所谓“珠徙珠还”，此煞定死谱，非真有清官感召也。（我朝弘治中，一采得二万八千两，万历中一采只得三千两，不偿所费。）

【今译】

一颗价值千金。这就是古来所谓“明月珠”、“夜光珠”。这种珠白天晴天时在屋檐下可看到一线闪烁不定的光。“夜光珠”是其美称，并非真有夜间放光的珍珠。其次是走珠，放在平底盘中滚动不停，价亦与瑇珠相仿。（传说死人口中含一颗，则尸体不腐烂，故帝王之家要用重金购买它。）再其次还有滑珠，色光而形不甚圆，其次还有螺蚶珠、官珠、雨珠、税珠、葱符珠。小的珠如小米粒大，通常的珠如豌豆。破碎的次珠叫玢珠，从夜光珠直到碎玢珠，好比人从王公到奴隶一样，分为不少等级。

珍珠的产生有一定限度，如果采取过于频繁，珠的生长就会来不及供应。只有经过几十年不采，使蚌能安其身繁殖后代，才能更多地孕育出珠。所谓“珠徙珠还”之说，是不通情理的杜撰，并不是真有受清官感召，使迁移的珠又返还的事。（本朝弘治年间有一年采珠二万八千两，万历年间有一年只采得三千两，得不偿失。）



shape, just like an inverted cooking pot, with one side highly lustrous and suggesting gold plating. A pendant pearl is reportedly worth a thousand pieces of gold. And it is called “bright moon” or “light at night”. The reason why it has such a beautiful name is that it glimmers with a thread of light when it is held against sunshine. The reason that such pearls are called “light at night” is not because they really shine in the dark of night. Next in value is the “running pearls” which will roll around without stopping if they are placed in a flat-bottom plate. They are as expensive as the “pendant pearls”. (It is said that the corpus with this pearl in the mouth will not decompose so that monarchs pay huge sums of money for them.) Still next are the “shining pearls”, which have bright color but the shapes of which are not round enough. And still next are “snail shell pearls”, “official pearls”, “rain pearls”, “tax pearls”, and “green tally pearls”. Pearls can be as small as a grain of millet. Ordinary pearls are as big as peas, and the odd-shaped and broken pearls are called “*ji* pearls”. All these grades of pearls, ranging from “light-at-night pearls” to the “*ji* pearls” are ranked like people from emperors to slaves.

Pearls are limited in number. If they are taken frequently, they will become exhausted. If they are undisturbed for a few decades, the mussels or oysters will live in peace and increase their chance of progeny. And thus they will produce large quantities of precious gems. There is a saying, “Pearls return where mussels are.” It does not mean that the migrated pearls come back to the areas where they were produced under the inspiration of upright officials. (During the reign of Emperor Hongzhi, the pearl production for one particular year was 28,000 *liang* while one year in the Emperor Wanli reign in the Ming Dynasty, it was only 3,000 *liang* which was not worth the cost.)



【原文】

宝

凡宝石皆出井中，西番诸域最盛。中国唯出云南金齿卫与丽江两处。凡宝石自大至小，皆有石床包其外，如玉之有璞。金银必积土其上，蕴结乃成。而宝则不然，从井底直透上空，取日精月华之气而就，故生质有光明。如玉产峻湍，珠孕水底，其义一也。

凡产宝之井，即极深无水，此乾坤派设机关。但其中宝气如雾，氤氲井中，人久食其气多致死。故采宝之人或结十数为群，入井者得其半，而井上众人共得其半也。下井人以长绳系腰，腰带叉口袋两条，及泉近宝石，随手疾拾入袋（宝井内不容蛇虫）。腰带一巨铃，宝气逼不得过，则急摇其铃。井上人引绳提上。其人即无恙，然已昏蒙。只与白滚汤入口解散，三日之内不得进食粮，然后调理平复。

【今译】

宝 石

宝石都产于井下，中国西部新疆地区各地出产最多，中原只出于云南金齿卫与丽江两处。宝石不论大小都有石床包在外面，如玉之有璞。金银都是聚集在地下经长期蕴结而成。而宝石则不然，从井底直透天空，取日精月华之气而形成，因此生来就发光。像玉产于湍流水中、珠孕于水底一样，道理是相同的。

产宝石的井虽然极深，却没有水，这是大自然的巧妙安排。但井中的宝气像雾那样弥漫其中，人久吸其气，多数会致死。故采宝者经常十几个人结伴取宝，入井者得一半宝石，井上众人得另一半。下井人以长绳系腰，腰上带两个口袋，下井得到宝石后就赶紧拾起装入袋中（宝石井中不藏蛇虫）。腰间还悬一巨铃，当宝气逼得受不了时，急忙摇铃，由井上人用绳拉出来，即使没有危险，但已昏迷不醒。这时只能用白开水灌入口内解救，三日之内不得吃粮食，然后



Gems

All gem stones are produced in deep mines. Xinjiang in West China, has the highest output of gem stones, while in the Central Plains, gem stones can only be found in Jinchiwei and Lijiang in Yunnan Province. Just like the fact that jades are contained in the rock crust, no matter what size, all gem stones are enveloped in stone deposits. Different from gold and silver, which have been formed underground over a long period of time, gem stones are formed with the pith of sunlight and moonlight when the mines are open to air. As a result, they are luminous by nature. The principle is the same as the fact that jades are produced in torrents and pearls in deep water.

It is an ingenious arrangement that there is no water in the extremely deep mines in which gem stones are produced. Instead they are filled with a foggy "gem vapor" which remains in the pits and is fatal to humans after prolonged exposure. Dozens of diggers are searching for the treasures together. A miner who goes down into the mines gets half of the stones, and the others waiting at the mouth of the mine get the other half. The miner has a long rope tied to his waist, two bags are also hung from a belt at his waist. The gem stones are put into the two bags as soon as they are discovered. (There are no snakes or insects in the mines.) There is also a big bell tied at the miner's waist so that when he feels suffocated by the gem vapor, he rings the bell immediately. Then he will be pulled up by people above the ground by the rope. Usually the miner will be in a coma although probably not at death's door. Only by forcing him to drink some boiling-hot water can he be saved. For the next three days, he is not allowed to eat anything. Then he will recover his normal health. In the miner's bags, the biggest gem stones



下井采宝
A miner in a gem pit



宝气饱闷

Miner overcome by gem vapor



【原文】

其袋内石大者如碗，中者如拳，小者如豆，总不晓其中何等色。付与琢工铤错解开，然后知其为何等色也。

属红黄种类者，为猫精、靺羯芽、星汉砂、琥珀、木难、酒黄、喇子。猫精黄而微带红。琥珀最贵者名璧，红而微带黑。然昼见则黑，灯光下则红甚也。木难纯黄色，喇子纯红。前代何妄人，于松树注茯苓，又注琥珀，可笑也。

属青绿种类者，为瑟瑟珠、祖母绿、鸦鹛石、空青之类（空青既取内质，其膜升打为曾青）。至玫瑰一种，如黄豆、绿豆大者，则红、碧、青、黄数色皆具。宝石有玫瑰，如珠之有玕也。星汉砂以上，犹有煮海金丹。此等皆西番产，其间气出，滇中井所无。时人伪造者，唯琥珀易假。高者煮化硫黄，低者以殷红汁料煮入牛羊明角，映照红赤隐然，今亦最易辨认（琥珀磨之有浆）。至引草，原惑人之说，

【今译】

再调理恢复。袋内的宝石，大者如碗，中者如拳，小者如豆，总不能马上晓得里面是何等货色。需要交给琢工用铤刀铤开后，才知道是什么成色。

属于红、黄色种类的宝石叫猫精、靺羯芽、星汉砂、琥珀、木难、酒黄、喇子。猫精石黄色而微带红。琥珀最贵重的叫璧，红色而略微带黑，但白天看是黑色，灯光下看则甚红。木难为纯黄色，喇子是纯红色。前代不知有哪位妄人，在谈到松树时加注说可变成茯苓，又加注说可变成琥珀，这是可笑的。

属于青绿色种类的宝石，有瑟瑟珠、祖母绿、鸦鹛石、空青等（空青取自矿石内核，外层打成粉末即为曾青）。有一种玫瑰石，像黄豆、绿豆那样大，有红、绿、青、黄等几种颜色。宝石中有次等的玫瑰石，就像珍珠中有次等的玕珠那样。比星汉砂高一等的还有煮海金丹。这些都是西部新疆地区出产的，偶然也有随着井中宝气出现的，云南中部矿井没有这类宝石。现在有人伪造宝石，只有琥珀最易作假。高明的则煮化硫黄，低劣的以黑红色汁液煮透明的牛羊角胶，映照之下，隐约可见红色，但是现在也极易辨认出来（琥珀研磨时有浆）。



they get are as big as bowls, while the smallest ones are as small as beans and the medium as big as fists. Not until they are filed by the gem polisher will they know the qualities of these stones.

Chrysoberyl, cornelian, aventurine, amber, yellow beryl, topaz and ruby are kinds of gem stones that are red and yellow. Chrysoberyl is reddish yellow. The most valuable ambers are called “yi” (the price of which is five times that of gold). Blackish red, it looks black during the day and red by lamplight. Beryl is pure yellow and ruby is pure red. A foolish writer in the old days marked down amber together with the China-root fungus in association with pine trees. How ridiculous it is!

Gem stones such as sapphire, emerald, titanic sapphire and malachite are blue green. (Malachite is taken from the kernel of ore. It is called malachite powder when the outer layer is polished into powder.) “Rose stones” are as big as soybeans or mung beans and have colors like red, green, blue and yellow. The status of rose stones in gem stones is just like that of “ji pearls”. The rank of “*Zhu Hai Jin Dan*” (a kind of reddish gem stone) is higher than that of aventurine. All these are produced in Xinjiang in West China and cannot be found in Yunnan Province. Nowadays some people forge gem stones, among which amber is the easiest to forge. The better grade of the forged gem stones is made of melted sulphur, while the lower grade of forged gem stones is made of ox or sheep’s horn boiled in dark red juice. When it is held before the light a red shade can be seen. But it is now very easy to distinguish a piece of false amber from a real one (since there will be plasma when genuine amber stones are whetted). The statement that ambers can attract lamp-wick grass is groundless that serves only to confuse people. With the help of



【原文】

凡物借人气能引拾轻芥也。

玉

凡玉入中国，贵重用者尽出于阆、葱岭。所谓蓝田，即葱岭出玉别地名，而后世误以为西安之蓝田也。其岭水发源名阿耨山，至葱岭分界两河，一曰白玉河，一曰绿玉河。后晋人高居海作《于阆行程记》，载有乌玉河，此节则妄也。

玉璞不藏深土，源泉峻急，激映而生。然取者不于所生处，以急湍无着手。俟其夏月水涨，璞随湍流徙，或百里，或二三百里，取之河中。凡玉映月精光而生，故国人沿河取玉者，多于秋间明月夜，望河候视。玉璞堆积处，其月色倍明亮。凡璞随水流，仍错杂乱石浅流之中，提出辨认而后知也。

白玉河流向东南，绿玉河流向西北。亦力把里地，其地有名望

【今译】

至于讲琥珀能吸引小草，本为欺人之谈。凡物只有借人气才能吸引轻微草芥。

玉

贩运到中原内地的玉，贵重的都出在于阆、葱岭。所谓蓝田，是出玉的葱岭的另一地名，而后世误以为是西安附近的蓝田。葱岭的河水发源于阿耨山，流到葱岭后分为两条河，一曰白玉河，一曰绿玉河。后晋人高居海作《于阆行程记》载有乌玉河，这段记载是错误的。

含玉的石不藏于深土，而是在靠近山间河源处的急流河水中激映而生。但采玉的人并不去原产地采，因为河水流急而无从下手。待夏天涨水时，含玉之石随湍流冲至一百里或二三百里处，再在河中采玉。玉是感受月之精光而生，所以当地人沿河取石多是在秋天明月之夜，守在河处观察。含玉之石堆聚的地方，那里的月光就显得倍加明亮。含玉的璞石随河水而流，免不了要夹杂些浅滩上的乱石，只有采出来经过辨认而后才知何者为玉、何者为石。

白玉河流向东南，绿玉河流向西北。亦力把里地区有个地方叫望野，附近河水多聚玉。当地的风俗是由妇女赤身下水取玉，据说是由



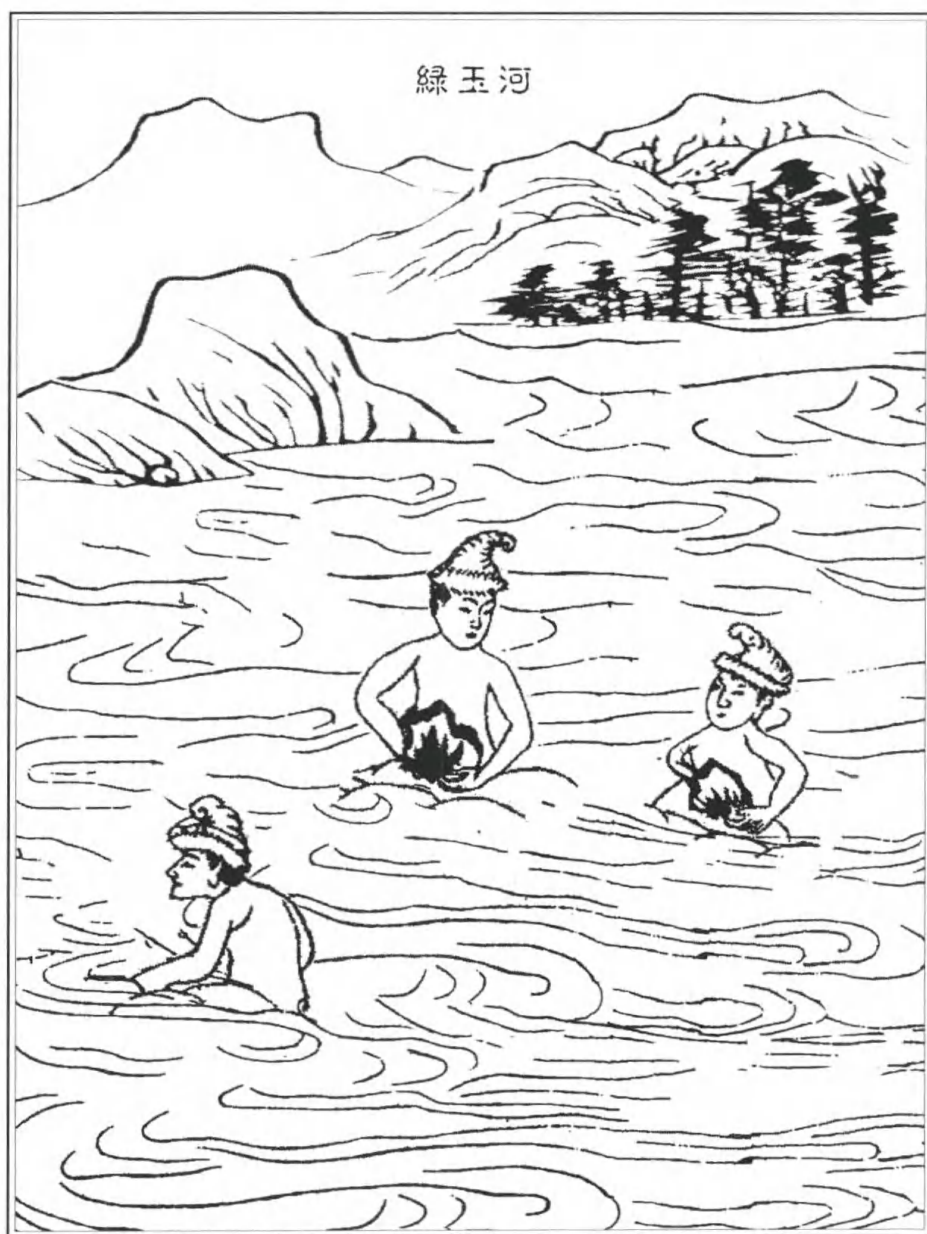
human power, all materials can attract the small and light particles.

Jade

All valuable jade that are transported to and sold in the Central Plains are produced in Yutian and Congling. The name “Lantian” is another name for Congling. However, the later generations thought it was a place near Xi’an which was also called Lantian. The river of Congling rises in Anou Hill and divides into two at Congling, one called the White Jade River and the other the Green Jade River. The book *Travels in Yutian*, by the Jin Dynasty writer Gao Juhui, mentions a Black-Jade River, which is a mistake.

The stones containing jade are not buried deep in the earth, instead, they can be found in the rushing water near the riverheads in mountains. However, miners do not go to the river origins for jade since the swift current makes it difficult to find them. They wait until the streams are swollen in summer, when the crude jade will be carried away by the current and can be gathered from the river, perhaps 100 or even 200 or 300 *li* from their original deposits. Since jade is formed by the shining essence of moonlight, local residents usually search for the stones along the rivers when the moon is bright in autumn. It will be brighter where there are stones containing jade. The rock crust is bound to be mixed with gravel on the bank, so that only by cutting could the value of the stones be known.

The White Jade River flows southeastward while the Green Jade River flows northwestward. There is a place called Wangye in Ilibalik where jade is easily found in the nearby rivers. There is a local custom that women should search for jade naked in the water. The reason is that jade will be attracted by women’s *Yin* aura, and thus stop flowing



綠玉河
The Green Jade River



琢玉
Cutting jade



【原文】

野者，河水多聚玉。其俗以女人赤身没水而取者，云阴气相召，则玉留不逝，易于捞取。此或夷人之愚也（夷中不贵此物，更流数百里，途远莫货，则弃而不用）。

凡玉唯白与绿两色。绿者中国名菜玉，其赤玉、黄玉之说，皆奇石、琅玕之类。价即不下于玉，然非玉也。凡玉璞，根系山石流水。未推出位时，璞中玉软如绵絮，推出位时则已硬，入尘见风则愈硬。谓世间琢磨有软玉，则又非也。凡璞藏玉，其外者曰玉皮，取为砚托之类，其价无几。璞中之玉，有纵横尺余无瑕玷者，古者帝王取以为玺。所谓连城之璧，亦不易得。其纵横五六寸无瑕者，治以为杯斝，此已当时重宝也。

此外，唯西洋琐里有异玉，平时白色，晴日下看映出红色，阴雨时又为青色，此可谓之玉妖，尚方有之。朝鲜西北太尉山有千年璞，中藏羊脂玉，与葱岭美者无殊异。凡玉由彼地缠头回或溯河舟，或驾橐驼，经庄浪入嘉峪，而至于甘州与肃州。中国贩玉者，至此互

【今译】

于受妇女的阴气相召，玉就会停而不流，易于捞取。这或可说明当地人不明事理（当地并不贵重此物，如果沿河再过数百里，路途远，卖不出去，便弃而不用）。

玉只有白、绿两种颜色，绿玉在中原地区叫菜玉。所谓赤玉、黄玉之说，都指奇石、琅玕之类，虽然价钱不下于玉，但终究不是玉。含玉之石产于山石流水之中，未剖出时璞中之玉软如绵絮，剖露出来后就已变硬，遇到风尘则变得更硬。世间有所谓琢磨软玉的，这又错了。玉藏于璞中，其外层叫玉皮，取来作砚和托座，值不了多少钱。璞中之玉有纵横一尺多而无瑕疵的，古时帝王用以作印玺。所谓价值连城之璧，亦不易得。纵横五六寸而无瑕的玉，用来加工成酒器，这在当时已经是重宝了。

此外，只有西洋琐里产有异玉，平时白色，晴天在阳光下显出红色，阴雨时又成青色，这可称为玉妖，宫廷内才有这种玉。朝鲜西北的太尉山有一种千年璞，中间藏有羊脂玉，与葱岭所出的美玉没有什么不同。玉由葱岭的缠头的回族人或者是沿河乘船，或者是



and will be found easily. This probably results from the ignorance of local people. (Jade is not considered valuable here. If not sold when they travel along the river for miles, people there will regard it useless and throw it away.)

Jade has only two colors: white and green. Green jade is called “vegetable jade” in the Central Plains. The so-called red jade and yellow jade are in effect unique stones. Lang Gan (jade-like stones) is as expensive as jade but are not jade at all. The stones containing jade are found in the rushing water coming down from mountains. The jade within these stones is as soft as cotton. As soon as the jade is cut open, it becomes hard and even becomes harder after it is carried to the river mud and fanned by the wind. As a result, it is wrong to say that there is a kind of “soft jade” that can be polished and used. The outer layer of the jade within the rock is called “jade skin”. This is cheap and can be used to make ink-stones and supporting saucers. The one-cubic-*chi* jade without any blemishes was used to make royal seals for monarchs in ancient times. This sort of jade is known as “the jade worth the value of several cities”. The jade which is five or six *cun* in length and breadth is made into drinking sets. They are considered precious at that time.

Besides, only in *Suoli* of Coromandel can we find the “unusual jades” which are white most of the time, reddish in the sun and bluish when it is rainy or cloudy. This can be called “the jade spirit” which can only be seen in royal courts. On Taiwei Mountain in Northwest Korea there is a kind of rock crust which has an extremely long history. The white jade contained in it is the same as that produced in Congling. The jade from Congling is transported to Jiayuguan Pass through Zhuanglangwei, and finally to Ganzhou and Suzhou in Gansu Province by the Turbaned Moslems. The jade dealers from the hinterland buy



【原文】

市得之，东入中华，卸萃燕京。玉工辨璞高下定价，而后琢之（良玉虽集京师，工巧则推苏郡）。

凡玉初剖时，冶铁为圆盘，以盆水盛沙，足踏圆盘使转，添沙剖玉，逐忽划断。中国解玉沙出顺天玉田与真定、邢台两邑。其沙非出河中，有泉流出精粹如面，借以攻玉，永无耗折。既解之后，别施精巧工夫。得镵铁刀者，则为利器也（镵铁亦出西番哈密卫砺石中，剖之乃得）。

凡玉器琢余碎，取入钿花用。又碎不堪者，碾筛和泥涂琴瑟。琴有玉声，以此故也。凡镂刻绝细处，难施锥刃者，以蟾酥填画而后钹之。物理制服，殆不可晓。凡假玉以砮碱充者，如锡之于银，昭

【今译】

骑骆驼，经庄浪卫运入嘉峪关，而到甘肃甘州、肃州。内地贩玉的人来到这里从互市而得到玉后，再向东运，一直会集到北京卸货。玉工辨别玉石等级而定价后开始琢磨（良玉虽集中于北京，但琢玉的工巧则首推苏州）。

开始剖玉时，用铁做个圆形转盘，将水与沙放入盆内，用脚踏动圆盘旋转，再添沙剖玉，一点点把玉划断。剖玉所用的沙，在内地出自顺天府玉田和真定府邢台两地，此沙不是产于河中，而是从泉中流出的细如面粉的细沙，用以磨玉永不耗损。玉石剖开后，再用一种利器镵铁刀施以精巧工艺制成玉器（镵铁也出于新疆哈密的类似磨刀石的岩石中，剖开就能炼取）。

琢磨玉器时剩下的碎玉，可取来做钿花。碎不堪用的则碾成粉，过筛后与灰混合来涂琴瑟，由此使琴有玉器的音色。雕刻玉器时，在细微的地方难以下锥刀，就以蟾蜍汁填画在玉上，再以刀刻。这种一物克一物的道理还难弄清。用砮碱冒充玉，有如以锡充银，很



jade in the markets and then transport them to the east. Finally they deliver the goods to Beijing. The jade carvers begin to polish the stones after deciding on the grades of jade and fixing their prices. (Though fine jade is collected in Beijing, the art of carving jade is the best in Suzhou.)

As the cutting begins, a round iron disc is made and mounted on a frame connected with pedals underneath and a basin of sand is placed beside it. The disc is turned by pedals, at the same time sand is sprinkled on it so as to cut through the jade. Finally the jade will be cut open as sand is gradually added into the basin. The sand for cutting jade is produced in Yutian of Shuntian Prefecture and Xingtai of Zhending Prefecture. This kind of sand is as fine as flour and flows out of springs, not rivers. It will never wear off by using this kind of sand. After the stone is cut open, the jade is produced into jade articles with ingenious crafts by an edge tool called a wrought iron knife. (Wrought iron is also produced from the rocks similar to whetstones found in Hami, Xinjiang. It is refinable upon cutting).

Jade fragments left from cuttings can be used to make inlays. Fragments that are over broken can be ground into powder. After being sifted, the powder can be blended with ashes to fill the cracks in lutes so that the instruments will have the timbre of jade articles. Venom of toads can be smeared onto the jade when it is too tiny for wimbles and broadswords. The way in which different things in nature are able to control each other is indeed mysterious. The difference between genuine jade and jade simulated from inferior agates is similar to the difference between silver and tin. It is very easy to detect. Recently the craftiest method for making artificial jade has appeared: pound first-class porcelain into extremely fine powder and mix it with *Radix am-pelopsis* juice and form it into utensils which radiate with the color of



【原文】

然易辨。近则捣春上料白瓷器，细过微尘，以白菰诸汁调成为器，干燥玉色烨然，此伪最巧云。

凡珠玉、金银胎性相反。金银受日精，必沉埋深土结成。珠玉、宝石受月华，不受寸土掩盖。宝石在井，上透碧空，珠在重渊，玉在峻滩，但受空明、水色盖上。珠有螺城，螺母居中，龙神守护，人不敢犯。数应入世用者，螺母推出人取。玉初孕处，亦不可得。玉神推徙入河，然后恣取，与珠宫同神异云。

玛瑙、水晶、琉璃

凡玛瑙非石非玉，中国产处颇多，种类以十余计。得者多为簪簪、扣结之类，或为棋子，最大者为屏风及桌面。上品者产宁夏外微羌地砂碛中，然中国即广有，商贩者亦不远涉也。今京师货者，多是大同、蔚州九空山、宣府四角山所产。有夹胎玛瑙、截子玛瑙、

【今译】

容易辨别。最近有将上料白瓷器捣得极碎，再用白菰等汁液粘调成器物，干燥后有发光的玉色，这种作伪方法最为巧妙。

珠玉与金银的生成方式相反。金银受日精，必定埋在深土内形成。而珠玉、宝石则受月华，不要一点泥土掩盖。宝石在井中直透青空，珠在深水里，而玉在险峻湍急的河滩，但都受着明亮的天空或河水覆盖。珠有螺城，螺母在里面，由龙神守护，人不敢犯。那些注定应用于世间的珠，由螺母推出供人取用。在原来孕玉的地方，也无法令人接近。只有由玉神将其推迁到河里，才能任人采取，与珠宫同属神异。

玛瑙、水晶、琉璃

玛瑙既不是石，也不是玉，中国出产的地方很多，有十几个种类。所得到的玛瑙，多用作发髻上别的簪子和衣扣之类，或者作棋子，最大的作屏风及桌面。上等玛瑙产于宁夏塞外羌族地区的沙漠中，但内地也到处都有，商贩不必去那样远的地方贩运。现在在北京所卖的，多产于山西大同、河南蔚县九空山及河北宣化的四角山，有夹胎玛瑙、截子玛瑙、锦江玛瑙，种类不一。而陕西神木与府谷



jade after they become dry.

The methods of creating pearls and jades are opposite to that of gold and silver which are created with the help of pith of the sun and should be formed deep in the earth. Pearls and jade should not be covered by any soil. Gem stones are produced in mines open to air, pearls in deep water, and jade in riversides along rapid rivers. All need only the covering of air and water. Pearls reside in spiral shells with mussel mothers in them and are protected by the dragon gods from human's offence. Those pearls which are destined to be enjoyed in the human world are provided by mussel mothers. Places where jade is produced are also inaccessible unless the jade gods push them into the rivers. They could be picked by people. It is as magical as the pearl palaces.

Agate, Crystal and Colored Glaze

Agate is neither stone nor jade. There are a lot of places where agate is produced, and there are dozens of kinds of agate which are mostly used to make hair ornaments and fasteners or chessmen. The biggest agate can be used to make folding screens and table tops. The first-class agate is produced in the desert of Qiang ethnic area north of the Great Wall of Ningxia, but they can also be found everywhere in the backland so that pedlars do not have to go that far to sell them. Most of the agate sold in Beijing now is produced in Datong of Shanxi Province, Jiukong Mountain in Wei County of Henan Province and Si-jiao Mountain in Xuanhua of Hebei Province, and includes the "two-colored agate", "black-white agate", and "red-flower agate". Further, "watery agate" and "red-white veined agate" are produced in Shenmu and Fugu of Shaanxi Province, and are sold in local places. The above is a brief summary of agate. To test whether the agate is genuine or



【原文】

锦江玛瑙，是不一类。而神木、府谷出浆水玛瑙、缠丝玛瑙，随方货鬻，此其大端云。试法以研木不热者为真。伪者虽易为，然真者值原不甚贵，故不乐售其技也。

凡中国产水晶，视玛瑙少杀。今南方用者多福建漳浦产（山名铜山），北方用者多宣府黄尖山产，中土用者多河南信阳州（黑色者最美）与湖广兴国州（潘家山）产。黑色者产北不产南。其他山穴本有之，而采识未到，与已经采识而官司严禁封闭（如广信俱中官开采之类）者，尚多也。凡水晶，出深山穴内瀑流石罅之中。其水经晶流出，昼夜不断，流出洞门半里许，其面尚如油珠滚沸。凡水晶未离穴时如绵软，见风方坚硬。琢工得宜者，就山穴成粗坯，然后持归加功，省力十倍云。

凡琉璃石与中国水晶、占城火齐，其类相同，同一精光明透之义。然不产中国，产于西域。其石五色皆具，中华人艳之，遂竭人巧以肖之。于是烧瓴甗，转釉成黄绿色者，曰琉璃瓦。煎化羊角为盛油

【今译】

所产的是浆水玛瑙、缠丝玛瑙，就地卖出，这是大致情况。辨试的方法是用木头在玛瑙上摩擦，不发热的是真品。伪品虽容易做，但真品价钱原来就不怎么高，所以人们也就不愿意多费手脚了。

中国产的水晶要比玛瑙少些，现在南方所用的多产于福建漳浦（当地的山叫铜山），北方所用的多产于河北宣化的黄尖山，中原用的多产于河南信阳（黑色的最美）与湖北兴国（潘家山）。黑色的水晶产于北方，不产于南方。其余地方山穴中本来就有，而没被发现与采取；或已经发现并采取，而受到官方严禁并封闭（例如江西广信地区惧害宫里派的宦官盘削而停采）等等。这种情况不在少数。水晶产于深山洞穴内的瀑流、石缝之中，瀑布昼夜不停地流过水晶，流出洞口半里左右，水面上还像油珠那样翻花。水晶未离洞穴时是绵软的，风吹后才坚硬。琢工为了方便，在山穴就地制成粗坯，再带回去加工，可省力十倍。

琉璃石与中国水晶、占城的火齐同类，都光亮透明，但不产于中国内地，而产于新疆及其以西地区。这种石五色俱全，国内的人都喜欢，遂竭尽工巧来仿制。于是烧成砖瓦，挂上琉璃石釉料成为黄、绿颜色的，叫做琉璃瓦。将琉璃石与羊角煎化，便制成琉璃碗，用以盛



false, rub it against a piece of wood. If it is still cold, then it is genuine. Although it is easy to make artificial agate, few people attempt it because the price of genuine agate is not very high.

The output of crystal is less than that of agate. At present most of the crystal used in South China is produced in Zhangpu, Fujian Province (a local hill called Tong Hill), while in North China most of it is produced in Huangjian Hill of Xuanhua, Hebei Province. In the Central Plains, Xinyang of Henan Province (the most beautiful are the black ones) and Panjia Hill in Xingguo of Hubei Province produce the most crystal. Black crystal is produced in North China, not South China. In the caves of other places there have been some crystals, but they have not been discovered and mined. Where they have been discovered, the exploitation has been prohibited by the government and the caves are closed down (For example, the production in Guangxin of Jiangxi Prefecture has been prevented for fear of exploitation by eunuchs from the palace), which is a frequent occurrence. Crystal is produced in the chutes and crevices in the rocks of caves in the remote mountains. Waterfalls wash the crystals day and night and rush them about half a *li* away from the mouth of the cave. The surface of the water still presents a boiling appearance, as though there were oil droplets in it. Crystal is soft before it leaves the mouth of caves and becomes hard by being exposed to the air. For convenience, carvers make crystal into crude blanks on the spot, and then take them back for further processing. This can save decuple labor.

Lapis lazuli is similar to Chinese quartz crystal and champa quartz-crystal prism. Both of them are produced in Xinjiang and places west of that, not the inland of China. This kind of stone is multicolored. It is loved by the countrymen and is modeled on with various exquisite



【原文】

与笼烛者，为琉璃碗。合化硝、铅泻珠铜线穿合者，为琉璃灯。捏片为琉璃袋（硝用煎炼，上结马牙者）。各色颜料汁，任从点染。凡为灯、珠，皆淮北、齐地人，以其地产硝之故。

凡硝见火还空，其质本无，而黑铅为重质之物。两物假火为媒，硝欲引铅还空，铅欲留硝住世，和同一釜之中，透出光明形象。此乾坤造化，隐现于容易地面。

《天工》卷末，著而出之。

油或作灯罩。将羊角、硝石、铅与用铜线穿起来的火齐珠合在一起炼化，可制成琉璃灯。用上述材料烧炼后还可捏制成薄片，做成琉璃瓶（所用硝石用煎炼时结在上面的马牙硝）。可用各种颜料汁任意将材料染成颜色。制造琉璃灯和琉璃珠的，都是淮北人和山东人，因为这些地方出产硝石。

硝石灼烧后便分解而消失，其原来成分便不再存在，而黑铅是重质之物。两种物质通过火的媒介而发生变化，硝吸引铅而自身消失，铅与硝结合以保留其存在，它们与琉璃石、羊角等在同一釜中烧炼而炼出透明发光的玻璃。此乃自然界隐约的变化机制在该简单过程中之再现。

结束《天工开物》之际，特记于此。



crafts. Burned tiles covered with yellow or green quartz glaze are called glazed tiles or *liu-li-wa*. Glass bowls are made from the fusion of quartz and rams' horns and are used to contain oil or used as lampshades. The fusion of rams' horns, saltpeter, lead and quartz-crystal prism threaded by copper wires can be used to make glass lamps. The slices pressed with fusion of those materials can be used to make "lazurite vases". (The nitres used here are refined and horse-tooth-shaped crystals placed on the surface.) These materials can be dyed with various pigment juices. All the producers of glass lamps and glass beads come from Huaibei and Shandong where saltpeter is produced.

After being burned, saltpeter decomposes and disappears so that the original components do not exist any longer. Black lead, however, is a substance with big mass. Changes that saltpeter decomposes and lead exists through the integration with saltpeter have taken place to these two substances through the medium of fire. The fusion of these two materials together with quartz and rams' horns in the same pot becomes lucent glass. This is the reproduction of nature's transformation mechanism in a simple process.

With this, I finish my book of *Tian Gong Kai Wu* (*Industrial and Farming Techniques in Seventeenth-century China*).

附录

Appendix A

Equivalence of Chinese Weights and Measures in Metric Units

<i>chi</i> (尺) in centimeters	one <i>chi</i> is 31.10 centimeters
<i>cun</i> (寸) in centimeters	one <i>cun</i> is one tenth of a <i>chi</i> , that is 3.11 centimeters
<i>dan</i> (石) in liters	one <i>dan</i> is 107.4 liters
<i>dou</i> (斗) in liters	one <i>dou</i> is 10.74 liters
<i>jin</i> (斤) in grams	one <i>jin</i> is 596.82 grams
<i>liang</i> (两) in grams	one <i>liang</i> is 37.30 grams
<i>mu</i> (亩) in hectare	one <i>mu</i> is one fifteenth of a hectare, that is about 0.067 hectare
<i>sheng</i> (升) in liters	one <i>sheng</i> is 1.074 liters
<i>zhang</i> (丈) in centimeters	one <i>zhang</i> is 311 centimeters

Note: Ten *sheng* make one *dou* and ten *dou* make one *dan*.

Appendix B

The Twenty-four Solar Terms in China

Solar Term	Approximate Solar Date
立春 the Beginning of Spring (1 st solar term)	Feb. 3, 4 or 5
雨水 Rain Water (2 nd solar term)	Feb. 18, 19 or 20
惊蛰 the Waking of Insects (3 rd solar term)	Mar. 5, 6 or 7
春分 the Spring Equinox (4 th solar term)	Mar. 20, 21 or 22
清明 Pure Brightness (5 th solar term)	Apr. 4, 5 or 6





谷雨 Grain Rain (6 th solar term)	Apr. 19, 20 or 21
立夏 the Beginning of Summer (7 th solar term)	May 5, 6 or 7
小满 Lesser Fullness of Grain (8 th solar term)	May 20, 21 or 22
芒种 Grain in Beard (9 th solar term)	Jun. 5, 6 or 7
夏至 the Summer Solstice (10 th solar term)	Jun. 21 or 22
小暑 Lesser Heat (11 th solar term)	Jul. 6, 7 or 8
大暑 Greater Heat (12 th solar term)	Jul. 22, 23 or 24
立秋 the Beginning of Autumn (13 th solar term)	Aug. 7, 8 or 9
处暑 the End of Heat (14 th solar term)	Aug. 22, 23 or 24
白露 White Dew (15 th solar term)	Sep. 7, 8 or 9
秋分 the Autumn Equinox (16 th solar term)	Sep. 22, 23 or 24
寒露 Cold Dew (17 th solar term)	Oct. 8 or 9
霜降 Frost's Descent (18 th solar term)	Oct. 23 or 24
立冬 the Beginning of Winter (19 th solar term)	Nov. 7 or 8
小雪 Lesser Snow (20 th solar term)	Nov. 22 or 23
大雪 Greater Snow (21 st solar term)	Dec. 6, 7 or 8
冬至 the Winter Solstice (22 nd solar term)	Dec. 21, 22 or 23
小寒 Lesser Cold (23 rd solar term)	Jan. 5, 6 or 7
大寒 Greater Cold (24 th solar term)	Jan. 20 or 21



Appendix C

Chronological Table of the Chinese Dynasties

夏 Xia Dynasty	2100 B.C.—1600 B.C.
商 Shang Dynasty	1600 B.C.—1100 B.C.
周 Zhou Dynasty	
西周 Western Zhou Dynasty	1100 B.C.—771 B.C.
东周 Eastern Zhou Dynasty	770 B.C.—256 B.C.
春秋 Spring and Autumn Period	770 B.C.—476 B.C.
战国 Warring States Period	475 B.C.—221 B.C.
秦 Qin Dynasty	221 B.C.—206 B.C.
汉 Han Dynasty	
西汉 Western Han	206 B.C.—24 A.D.
东汉 Eastern Han	25 A.D.—220 A.D.
三国 Three Kingdoms	
魏 Wei	220 A.D.—265 A.D.
蜀汉 Shu Han	221 A.D.—263 A.D.
吴 Wu	222 A.D.—280 A.D.
西晋 Western Jin Dynasty	265 A.D.—316 A.D.
东晋 Eastern Jin Dynasty	317 A.D.—420 A.D.
南北朝 Northern and Southern Dynasty	
南朝 Southern Dynasty	420 A.D.—589 A.D.
宋 Song	420 A.D.—479 A.D.
齐 Qi	479 A.D.—502 A.D.
梁 Liang	502 A.D.—557 A.D.
陈 Chen	557 A.D.—589 A.D.
北朝 Northern Dynasty	
北魏 Northern Wei	386 A.D.—534 A.D.
东魏 Eastern Wei	534 A.D.—550 A.D.



北齐 Northern Qi	550 A.D.—577 A.D.
西魏 Western Wei	535 A.D.—556 A.D.
北周 Northern Zhou	557 A.D.—581 A.D.
隋 Sui Dynasty	581 A.D.—618 A.D.
唐 Tang Dynasty	618 A.D.—907 A.D.
五代 Five Dynasties	
后梁 Later Liang	907 A.D.—923 A.D.
后唐 Later Tang	923 A.D.—936 A.D.
后晋 Later Jin	936 A.D.—946 A.D.
后汉 Later Han	947 A.D.—950 A.D.
后周 Later Zhou	951 A.D.—960 A.D.
宋 Song Dynasty	
北宋 Northern Song Dynasty	960 A.D.—1127 A.D.
南宋 Southern Song Dynasty	127 A.D.—1279 A.D.
辽 Liao Dynasty	916 A.D.—1125 A.D.
金 Jin Dynasty	1115 A.D.—1234 A.D.
元 Yuan Dynasty	1271 A.D.—1368 A.D.
明 Ming Dynasty	1368 A.D.—1644 A.D.
清 Qing Dynasty	1644 A.D.—1911 A.D.



Appendix D Ancient and Modern Places Table

扬州 Yangzhou: in East China's Jiangsu Province

楚地 Land of Chu: part of Hubei, Hunan, Anhui and Jiangxi Provinces

荆州 Jingzhou: Jiangling in Hubei Province

广信府 Guangxin Prefecture: Shangrao in Jiangxi Province

九华山 Jiuhua Mountain: Qingyang County in Anhui Province

湖州府 Huzhou Prefecture: Wuxing in Zhejiang Province

安邑、猗氏、临晋 Anyi, Yishi and Linjin: the locality of Yuncheng in Shanxi Province

海丰 Haifeng : Salt Mountain County in Hebei Province

深州 Shenzhou : Shenxian County in Hebei Province

青州、沂水 Qingzhou and Yishui: Yidu and Yishui in Shandong Province

雅州 Yazhou: Ya'an in Sichuan Province

高州府 Gaozhou Prefecture : Maoming in Guangdong Province

太平府 Taiping Prefecture: Dangtu County in Anhui Province

真定府定州 Dingzhou of Zhending Prefecture: Ding County in Hebei Province

徽州府婺源县 Wuyuan County of the Huizhou Prefecture: Wuyuan in Jiangxi Province

徽州府祁门县 Qimen county of the Huizhou Prefecture: Qimen in Anhui Province

湖广 Huguang: Hubei, Guangdong and other Province

襄州 Xiangzhou: Xiangfan in Hubei Province

通州 Tongzhou: Tongzhou District of Beijing

天津卫 Tianjinwei: Tianjin

夷陵 Yiling: Yichang in Hubei Province

新滩 Xintan: Yougui of Hubei Province

潮州 Chaozhou : Chao'an in Guangdong Province
长安 Chang'an : Xi'an in Shaanxi Province
雷州 Leizhou : Haikang in Guangdong Province
廉州 Lianzhou : Hepu in Guangxi Zhuang Autonomous Region
淮扬地区 Huai'an and Yangzhou areas: in the northern part of Jiangsu
Province

